

NAME: Pratt & Whitney
I.D. NO: CTD 990672081
FILE LOC: R-11
OTHER: Vol III of III
RDMS # 3961

**RESOURCE CONSERVATION AND RECOVERY ACT
PART B PERMIT APPLICATION**

UNITED TECHNOLOGIES CORPORATION
PRATT & WHITNEY
400 MAIN STREET
EAST HARTFORD, CT 06108

EPA ID NO: CTD 990672081

VOLUME III

PREPARED BY

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NOVEMBER 12, 1990

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SECTION G - PERSONNEL TRAINING

1. General

Owners and operators of hazardous waste treatment, storage and disposal facilities are required to provide personnel with training in hazardous waste management and spill response procedures. A description of Pratt & Whitney's present personnel training program is contained herein. The program is currently being revamped to address all of the East Hartford Facility for all regulatory requirements related to hazardous materials/hazardous waste, one of which is RCRA. An overview of this anticipated program is provided in Part 3 of this section.

2. Training Program

Initial training is provided to new employees within their first six months on the job. During this time, the employee is not allowed to perform duties related to hazardous waste without supervision. All trained personnel receive the annual refresher course.

Training records for current employees are kept on file at the facility until final closure. Training records of former employees are kept for a minimum of three years after the date on which the employee terminated work.

The following is a curriculum outline of the initial training program that is provided to new employees by an outside contractor as well as an outline for the annual refresher course. Procedures are taught in a classroom setting.

a. Initial Training Course Outline

- Regulation Review
 - A. Pratt & Whitney Environmental Policy
 - B. Resource Conservation and Recovery Act (RCRA) Regulations, 40 CFR
 - C. Department of Transportation (DOT) Regulations 49 CFR
 - D. Connecticut State Environmental Protection Regulations
- Hazardous Waste Identification
 - A. Identification of Listed, Characteristic, Acutely Hazardous and Non-Hazardous Waste
 - B. New TCLP List
 - C. Hazardous Waste Generated at Pratt & Whitney
- Accumulation and Storage of Hazardous Waste
 - A. Storage requirements for hazardous waste and satellite accumulation areas.
 - B. Hazards associated with waste generated by Pratt & Whitney
 - C. Segregation of Incompatible Waste
 - D. Bonding and Grounding
 - E. Labeling
 - F. Inspection Records

- DOT Shipping Requirements
 - A. Packaging Requirements
 - B. Containers Used at Pratt & Whitney
 - C. Selecting a DOT Shipping Name
 - D. DOT Labels
 - E. EPA Container Markings
 - F. Placarding
- Uniform Hazardous Waste Manifest
 - A. Instructions for Properly Completing a Manifest
 - B. Filing Manifest Copies
- Land Ban Disposal Restrictions
 - A. Restriction Summary
 - B. Land Ban Materials
 - C. Notification of Restricted Waste
 - D. Treatment Standards for Pratt & Whitney Hazardous Waste
- Minimizing Hazardous Waste
 - A. Strategies to Reduce Quantity and Toxicity of Hazardous Waste.
 - B. Technologies Implemented at Pratt & Whitney Facilities
- Record Keeping and Reporting
 - A. Inspection Reports
 - B. Operating Logs
 - C. Manifests
 - D. Exception Reporting

- E. Annual Reporting
- F. Spill Reporting
- Contingency Plan
 - A. Purpose and Contents of Contingency Plan
 - B. Emergency Coordinator's Responsibilities
 - C. Incident Reporting
 - D. Communication and Alarm Systems at Various Pratt & Whitney Facilities
 - E. Evacuation Plans for Pratt & Whitney Facilities
- Emergency Response
 - A. Interpret information found in MSDS's, NFPA and HMIS labels
 - B. Selecting Personal Protective Clothing and Respirators.
 - C. Location and Use of Emergency Equipment
 - D. Emergency Response Procedures for Fires, Spills and Explosions
 - E. Preventative Measures
 - F. Notification Procedures

b. Annual Refresher Course Outline

The following is a curriculum outline of the annual refresher course. It is designed to re-emphasize the importance of proper waste management and spill response procedures while addressing new regulations and requirements.

- Regulation Update
- Hazardous Waste Identification

- A. Identification of Listed, Characteristic, Acutely Hazardous, new TCLP List.
- B. Hazardous Waste Generated at Pratt & Whitney Facilities.
- Labelling, Marking and Manifesting Hazardous Waste
 - A. Determining Proper DOT Shipping Name, Hazard Class and Identification Number.
 - B. Uniform Hazardous Waste Manifest.
 - C. Pratt & Whitney Internal Waste Manifest.
- Accumulation and Storage of Hazardous Waste
 - A. Requirements for Hazardous Waste Storage and Satellite Accumulation Areas.
 - B. Segregation of Hazardous Waste.
 - C. Selecting Proper DOT Container.
 - D. Drum Handling Techniques.
- Contingency Plan and Emergency Response
 - A. Description of Pratt & Whitney's Contingency Plan
 - B. Incident Reporting
 - C. Personal Protective Equipment and Respirator Selection.
 - D. Correct Use of Clean-Up Equipment.
 - E. Emergency Spill Procedures and Disposal Techniques.

3. Future Training Program

The training program is currently being revised to provide employees with a more comprehensive understanding of the hazardous waste management and spill response procedures as they relate to

individual job duties and responsibilities. The new program will incorporate the entire East Hartford Facility and address all regulatory requirements related to hazardous materials/hazardous wastes, including RCRA requirements.

The additional items in the new program include the following:

- An evaluation of each job function that involves hazardous waste will be performed to categorize job functions/titles into groups with similar exposures to hazardous waste and job duties. All job functions at P&W will be analyzed and a subset of these will be direct hazardous waste related job functions.
- Based on the exposure and job function requirements, the curriculum will be developed to match course content topics to training needs.
- Courses will be developed by utilizing the information from a job function/requirements/course title matrix.
- Documentation of the program will include:
 - A) A description of each job function/category (i.e. exposure, duties and required training course titles for that category).
 - B) The job/function/requirements/course titles matrix
 - C) Course description with outlines, delivery mechanisms and instructor qualifications.
 - D) Training recordkeeping procedures, documentation or automated tracking system.

E) Training program review and update procedures.

F) Administrative/management organization for training review, delivery, recordkeeping responsibilities, including duties, qualifications etc. of personnel assigned to administer the training program.

The proposed changes in the training program are currently being implemented and are expected to be completed by July, 1991.

4. Personnel Trained Under Current Program

Several groups of employees are trained under the current training program and will be retrained under the revised program after it is completed. Detailed job descriptions of facility positions currently trained are included in Appendix G-1. The names of the specific individuals filling these positions is maintained at the East Hartford facility. Because this list is continually being updated, it has not been included in this application.

a. Within the Environmental Protection Group the following have been trained:

	<u>Job Code</u>
Facilities Project Engineer	30.15.48
Sr. Facilities Engineer	30.15.46
Facilities Engineer	30.15.44
Engineering Associate	40.20.42

Individuals that are responsible for the overall management of hazardous waste are also currently trained. Their duties require that they maintain operating logs. These include monitoring records,

inspection logs, personnel training records and other required records. Generally, these people act as environmental compliance coordinators and they review regulations and are involved in systems management.

NOTE:

The job titles included here are limited only to department 6563 Environmental Protection Group. Other departments that have identical job titles are not included.

- b. Foreman (Supervisor), manufacturing; support or facility services (Job Code 185.13.92). Included are the Plant Engineering personnel that are responsible for the Concentrated Waste Treatment Plant and wastewater treatment plant on weekends and holidays. Duties involve responding to emergencies by implementing the Contingency Plan if necessary. Not all employees with this job title are assigned these duties.
- c. All Waste Treatment Operators are trained. Their job titles and corresponding job codes are as follows:

	<u>Job Code</u>
Working Leader, Chemical Waste Treatment	1120.3
Plant Operator - B, Chemical Waste Treatment	707.3
Plant Operator, Chemical Waste Treatment	707.2

These personnel are involved in the Waste Treatment Plant operations, hazardous waste movement and storage. Specific duties are described in referenced job descriptions.

- d. All waste storage and handling operators are trained. Their job title is Industrial Truck Operator (Job Code 134.4). These

personnel are responsible for movement, storage and handling of hazardous waste in the oil yard. Their specific duties are described in the referenced job description.

- e. The facilities emergency coordinators and alternate coordinators are also trained. These personnel have overall responsibility for Plant Engineering which has responsibility for hazardous waste management. Their duties as emergency coordinators are described in the Contingency Plan.

5. Training Director

The Training Director is responsible for developing and monitoring the RCRA Training Program. Ms. Veronica Hanzel is a Senior Facilities Engineer and serves as the Training Director at the East Hartford Plant. She has a formal education in the environmental management field. Ms. Hanzel has completed P&W's hazardous waste training course, an emergency response course, and a course in hazardous waste presented by Applied Environmental Technology (AET). In addition, she receives on the job training in performing her duties as a Senior Facilities Engineer.

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APPENDIX G-1

JOB DESCRIPTIONS

PRATT & WHITNEY, U.T.C. - SALARIED JOB DESCRIPTION

JOB TITLE: Facilities Project Engineer

JOB CODE: 030.15.48

EXEMPTION STATUS: Professional

BASIC FUNCTION: Responsible for planning, conducting and coordinating the design, construction, maintenance and modification of facilities, equipment and test structures, considering costs, time, program schedule and projected test requirements. Work closely with management and/or customers in defining objectives.

Typical Duties/Responsibilities may include, but are not limited to, the following:

- o Plan and conduct the most complex work involving the design, construction, maintenance and modification of facilities, equipment and test structure.
- o Initiate procurement request, work with and advise Purchasing and Division Counsel concerning bids, selecting contractor, procuring equipment and providing technical assistance.
- o Provide technical direction and/or engineering solutions on environmental issues.
- o May assign work to others and establish quality standards for phases of work.
- o Responsible for the completion of Key Job Requirements and other tasks related to this position as assigned by cognizant management.

TYPICAL QUALIFICATIONS: Bachelor's degree in related field plus appropriate experience, or equivalent qualifications.

DOCUMENT #:

030154889

PRATT & WHITNEY, U.T.C. - SALARIED JOB DESCRIPTION

JB TITLE: Senior Facilities Engineer

JOB CODE: 030.15.46

EXEMPTION STATUS: Professional

BASIC FUNCTION: Plan and carry out a variety of activities associated with the design, construction, maintenance and modification of facilities, equipment, test structures and customer support equipment. Work closely with management and/or customer in defining objectives.

Typical Duties/Responsibilities may include, but are not limited to, the following:

- o Investigate requests, analyze technical requirements, determine design and specifications and provide cost estimates for the more difficult construction and modification projects.
- o Plan, schedule, and coordinate the procurement of necessary material. Contact vendors concerning availability of equipment and discuss technical details and requirements of project. Consider incorporation of any new developments or process.
- o Maintain constant reviews, analyze operational difficulties and plan necessary changes, discussing with superior any unusual conditions and possible methods of correction.

Oversee preparation of various records and reports generated by group.

- o Responsible for the completion of Key Job Requirements and other tasks related to this position as assigned by cognizant management.

TYPICAL QUALIFICATIONS: Bachelor's degree in related field plus 3-5 years experience or equivalent qualifications.

DOCUMENT #: 030154689

PRATT & WHITNEY, U.T.C. - SALARIED JOB DESCRIPTION

JOB TITLE: Facilities Engineer

JOB CODE: 030.15.44

EXEMPTION STATUS: Professional

BASIC FUNCTION: Plan and carry out a variety of activities concerning the design, construction, maintenance and modification of facilities, equipment, test structures and customer support equipment. Work closely with management and/or customer to define objectives.

Typical Duties/Responsibilities may include, but are not limited to, the following:

- o Plan and perform activities concerning work with facilities, equipment and test structures.
- o Study requirements in terms of function, performance, overall dimensions, costs, and safety of operation to determine most satisfactory methods to accomplish objectives.
- o Develop basically new designs, as directed, or work out modifications or improvements.
- o Assist senior members of group with segments of complex projects in accordance with specific instructions.

Responsible for the completion of Key Job Requirements and other tasks related to this position as assigned by cognizant management.

TYPICAL QUALIFICATIONS: Bachelor's degree in related field plus 1-3 years experience or equivalent qualifications.

DOCUMENT #:

030154489

PRATT & WHITNEY, U.T.C. - SALARIED JOB DESCRIPTION

JOB TITLE: Engineering Associate

JOB CODE: 040.20.42

EXEMPTION STATUS: Professional

BASIC FUNCTION: Perform increasingly complex duties to carry out assignments while functioning within specific sections of a major unit.

Typical Duties/Responsibilities may include, but are not limited to, the following:

- o Work on a variety of assignments to develop specific skill areas and to enhance understanding of overall function of the unit.
- o Conduct studies, prepare analyses to produce the most satisfactory resolution to problems and prepare reports covering results of investigation.
- o Participate in and perform a variety of special assignments to gain exposure and familiarity with all aspects of the unit.
- o Responsible for the completion of Key Job Requirements and other tasks related to this position as assigned by cognizant management.

(TYPICAL QUALIFICATIONS: Bachelor's degree in related field or equivalent qualifications.

DOCUMENT #: 040204289

PRATT & WHITNEY, U.T.C. - SALARIED JOB DESCRIPTION

JOB TITLE: Foreman (Supervisor), Manufacturing Support or Facilities Services **JOB CODE:** 185.13.92

EXEMPTION STATUS: Administrative

BASIC FUNCTION: Directly supervises generally skilled hourly employees performing work related to the fabrication of tools, dies, or gages or the construction, maintenance, or repair of facilities or equipment. Performs administrative functions with respect to established policies, procedures, and methods to maintain disciplinary and technical control in terms of quality, costs, quantity, processes and materials involved.

Typical Duties/Responsibilities may include, but are not limited to, the following:

- o Establish effective work schedules for assigned areas considering customer requirements, priority issues, and human and equipment resource availability. Insure prompt and economical receipt of needed materials and supplies, and on-time delivery of finished products or services to customers.
- o Stay abreast of new developments and available technology in field of responsibility. Continuously review materials, equipment and processing methods used and evaluate the feasibility of modifying, replacing or modernizing capital resources to reduce costs or improve quality.
- o Work with and coordinate the local activities of various support organizations to ensure department equipment is properly maintained, employees are adequately trained and work in the safest possible environment, and labor relations activities are handled in a fair and equitable manner for both the Company and employees.
- o Utilize all available measuring techniques to evaluate the departments performance relative to the product or service provided to customers. Recommend alternative methods of providing high quality products and/or services at the lowest cost to improve the departments competitive position and profitability.
- o Responsible for the completion of Key Job Requirements and other tasks related to this position as assigned by cognizant management.
- o See reverse side for remaining Duties and Responsibilities.

TYPICAL QUALIFICATIONS: Apprenticeship or technical school training with 6-8 years shop experience or equivalent relevant experience.

DOCUMENT #: 185139289

**HOURLY JOB DESCRIPTION
PRATT & WHITNEY AIRCRAFT**

Job Title: WORKING LEADER, CHEMICAL WASTE TREATMENT

Dept. 26 Grade: 3 Job Code: 1120.3

Duties:

U.S.E.S. Code: _____ P.W.A. Occ. Group: 904

Assign and check work, instruct and perform same work as a group performing a variety of duties to process or store concentrated waste chemicals, waste oils, contaminated process water and other waste materials that are hazardous to the environment.

Plan and assign work to operators in accordance with general instructions of supervisor to meet changing priorities and maintain an even flow of work to optimize productivity. Instruct group regarding work requirements and methods, proper operating and checking procedures, safe working practices, use and care of the equipment and good housekeeping methods. Follow-up progress of work to assure compliance to procedures and methods, that instructions are understood and being carried out, and that quality standards are maintained. Assist operators with problems encountered in their work such as, malfunctioning equipment, difficulty in processing wastes, proper storage and labeling requirements, and changes in environmental rules and regulations. Confer with leaders of other shifts concerning status of work in process, unusual problems and changed requirements.

Work from generally defined procedures and Department of Environmental Protection regulations to oversee work of the group and make sure regulations concerning storage, labeling, sampling and processing meet standards. Monitor information from automated processing system which controls the continuous flow waste processing system to spot trends that indicate impending problems. Change operating parameters in the program to prevent conditions which could cause processed waste to exceed limits. Review waste materials shipped from other plants to make sure wastes, that can not be properly disposed of, are not accepted for storage. Take samples of questionable material and perform routine tests to determine contents or send samples to laboratory for more extensive testing. Work with small amounts of wastes to devise and improve methods for treating wastes where the method of treatment and chemicals used have been generally defined. Periodically take inventory of materials used to process wastes and notify supervisor when materials should be reordered. Check equipment such as pipes, pumps and tank liners for potential problems, and direct the work, and work with, the group to make minor repairs or notify supervisor when extensive repairs are required. Provide direction in case of emergency such as when leaks occur in chlorine or sulfur dioxide systems to clear the area, stop the flow, and locate leaks.

pt/1

Job Title: WORKING LEADER, CHEMICAL WASTE TREATMENT Dept: 26 Grade: 3 Job Code: 1 .3

FACTOR	SUBSTANTIATING DATA - HOURLY JOB RATING	DEG. PTS.
Education	Requires knowledge of basic chemistry, including chemical reactions, oxidation and reduction processes, acid-base reactions, and chemical symbols. Must be able to read schematic drawings, technical material, and flowmeters, pressure gages, and similar instruments.	3-42
Experience	3-4 years.	4-88
Initiative and Ingenuity	Under direction of immediate supervisor, follow standard practices and procedures to assign and check work, instruct and work with a group processing chemical wastes. Exercise judgement in planning work assignments to maintain an even flow of work, optimize productivity and assign work to individuals with their capabilities and requirements of the job. Make decisions in accepting wastes, monitoring trends and modifying program parameters in computerized system.	3-42
Physical Demand	Majority of time spent maintaining work flow, instructing group and checking work which requires light physical effort. Occasionally exert considerable effort for short periods to move heavy containers of waste or chemicals.	2-20
Mental or Visual Demand	Continuous mental and visual attention required to assign and check work, instruct employees, maintain work flow and perform same work as the group.	3-15
Responsibility Equip. & Process	Failure to instruct individuals in proper method of processing waste or transferring waste material through lines not designed to handle them, may result in damage to pipes, pumps, valves and other equipment. Probable damage would seldom exceed \$250.	3-15
Responsibility Material & Prod.	Errors in accepting waste or assuring treatment is proper may require additional treatment. Probable loss would seldom exceed \$100.	2-10
Responsibility Safety of Others	Failure to instruct group in safe work methods may cause violent reactions and result in disabling injuries to others.	4-20
Responsibility Work of Others	Responsible for assigning, instructing and checking work of a group of seldom over 10 employees.	3-15
Working Conditions	Exposed to odors in varying degrees from wastes and intermittently to heat and chemical dust. Work out of doors majority of time with exposure to prevailing weather conditions.	3-30
Unavoidable Hazards	Disabling injuries from leaks in piping and associated equipment, and from accidents involving treatment of wastes.	4-20

Total Pts

317

HOURLY JOB DESCRIPTION
PRATT & WHITNEY AIRCRAFT GROUP

Job Title: CHEMICAL WASTE TREATMENT PLANT OPERATOR - B

Dept:.....26..... **Grade:**.....7..... **Job Code:** 707.3.....

Duties:

U.S.E. Code:..... **P.W.A. Occ. Group:**.....904.....

Treat waste chemicals and oils following normal processing procedures to neutralize and dispose of them safely and pick up waste chemicals and deliver them to treatment plant. Rotate between each type of work on a regular schedule.

Follow procedures and specific instructions in processing a wide variety of wastes. Prepare lime slurries, ferric sulphate solutions and similar neutralizers by mixing powdered chemicals and water. Set up valves in various lines, and pump wastes from storage to processing tanks. Dilute acids as required to keep reaction temperatures low during processing. Open valves in agitating air and cooling water lines, start circulating pump and agitator motors, start the flow of neutralizers and set the flow rate as prescribed. Monitor the treatment and periodically test samples of the batch to determine when each stage of the process has been reached. Start flow of additional neutralizers and continue testing samples until wastes have been made harmless. Pump treated wastes to settling beds to dry, or transfer oils to other tanks for further processing.

Pump treated water-soluble and other waste oils into heated settling tanks to remove moisture and solids and otherwise prepare them for centrifuging. Pump oil across shaker table, through filters and centrifuge to remove more water and solids, and to the powerhouse to be burned.

Operate a fork lift truck to pickup acids, cyanides and other chemical wastes and deliver them to treatment plant for processing. Set up portable pump, transfer wastes from processing to transporter tank and fill out forms to identify the type and strength of the chemicals. Be alert to detect evidence of unusual chemical reactions and remove the material from the building as quickly as possible. Disassemble and clean centrifuge, replace filters, unload trucks and store lime and other material used in treating wastes. Keep records on the type and amount of wastes treated. As instructed, assist in repairing equipment and perform other similar work.

Refer difficulties encountered in treating wastes and performing other work to higher grade operator or Group Leader.

May assist in any type of maintenance and construction work as required.

cn
rs/2

Experience	6 - 12 months.	2-14	
Initiative and Ingenuity	Under direction of Group Leader, Chemical Waste Disposal Plant, follow standard procedures in performing repetitive work. Exercise care in setting up valves in lines to transfer wastes to processing tanks, setting flow rate of neutralizers, and in cleaning equipment. Make decisions in testing samples and determining whether treatment is progressing satisfactorily.	2-28	
Physical Demand	Most of work involves monitoring processes, testing samples, opening and closing valves which requires light effort. Occasionally exert considerable effort for short periods in handling heavy bags of chemicals.	2-20	
Mental or Visual Demand	Continuous mental and visual attention required in setting up valves in lines, monitoring processes, testing samples, and reading gages and meters. Constant alertness required to detect unusual chemical reactions and conditions that should be called to attention of others.	3-15	
Responsibility Equip. & Process	Failure to detect excessive reaction temperatures in processing tanks may result in damage to tank linings. Errors in pumping materials through lines not designed to handle them may result in damage to pipes, pumps, valves and other equipment. Probable damage would seldom exceed \$250.	3-15	
Responsibility Material & Prod.	Probable loss in processing waste materials would be negligible.	1- 5	
Responsibility Safety of Others	Failure to take action promptly when chemical reactions take place or carelessness in driving fork lift truck loaded with chemicals may result in severe injuries to others.	4-20	
Responsibility Work of Others	Responsible only for own work.	1- 5	
Working Conditions	Exposed to odors in varying degrees from wastes and intermittently to heat and chemical dust. Work out of doors majority of time with exposure to prevailing weather conditions.	3-30	
Unavoidable Hazards	Severe chemical burns from leaks in piping and associated equipment, and from accidents involving treatment of wastes.	4-20	230

HOURLY J. DESCRIPTION
PRATT & WHITNEY AIRCRAFT

Job Title: CHEMICAL WASTE TREATMENT PLANT OPERATOR

Dept.: 26 Grade: 5 Job Code: 707.2

Duties:

U.S.E.S. Code: _____ P.W.A. Occ. Group: 904

Treat concentrated waste chemicals, waste oils, contaminated rinse and other process water, and other waste material to neutralize pollutants and prepare materials for disposal.

Work from generally defined procedures in processing a wide variety of wastes. Check paper work accompanying incoming acids, alkalis and similar wastes to determine whether the type can be mixed with those already on hand, or whether they should be treated separately or used in treating other wastes. Dissolve dry chemicals in water or other wastes in receiving tank to prepare them for treatment. Be alert in dumping wastes into receiving tank to detect any indications of unforeseen reactions, and take action promptly to avoid accidents. Dilute strong acids to reduce hazards in processing or handling. Periodically test samples of treated wastes and continue adding chemicals until wastes have been rendered harmless. Periodically check flash point of oil in receiving tank and add higher flash point oils as required to prepare it for use as fuel.

Operate a fully automated, flow-through liquid waste treatment facility to remove contaminants from water used in industrial processes. Periodically test samples of treated water to make sure automatic sensing and control equipment is working properly. Mix chemical solutions used in the treatment of wastes, open clogged chemical feed lines, and perform other such work to keep the facilities running. At the pretreatment plant, where pollutants are neutralized, test samples of incoming wastes to detect unusually heavy concentrations of pollutants. Notify foreman of any that are found so a check of the area from which they are coming can be made for possible leaks or spills. At the Colt Street plant, where waste solids and oil are removed, test samples of incoming wastes to make sure pretreatment equipment is working properly. Monitor the process (flocculation) which removes solids, and test samples of clean water to make sure automatic equipment is holding pH at proper level. Operate vacuum filter to separate sludge from water and dry it.

Take action promptly in emergencies, such as when leaks occur in chlorine and sulphur dioxide systems, to clear the area, stop the flow and locate leaks. Make temporary repairs and notify proper repair group to have permanent repairs made. Replace valves, gaskets and short sections of pipe and tubing, and perform other similar types of repair work. Check linings on transport and processing tanks for evidence of cracks and other indications of deterioration. Remove debris from around oil skimmers on Willow Brook Pond, lubricate bearings and perform other preventive maintenance work on skimmers and dam, and adjust dam as necessary to control level of water in pond.

ph/2

mm

Job Title: CHEMICAL WASTE TREATMENT PLANT OPERATOR

Dept: 26

Grade: 5

Job Code: 707.2

FACTOR	SUBSTANTIATING DATA - HOURLY JOB RATING	Dep Pts
Education	Requires knowledge of basic chemistry, including chemical reactions, oxidation and reduction processes, acid-base reactions, and chemical symbols. Must be able to read schematic drawings, technical material, and flowmeters, pressure gages, and similar instruments.	3-42
Experience	2 - 3 years.	3-66
Initiative and Ingenuity	Under direction of foreman, follow standard practices in performing work of some complexity. Exercise judgment in determining whether to mix wastes, hold them to be treated separately, or to use them in treating other wastes. Make decisions concerning proper action to take in emergencies, and in determining what is causing unusual conditions.	3-42
Physical Demand	Most of work involves monitoring processes, testing samples, opening and closing valves which requires light effort. Occasionally exert considerable effort for short periods in handling heavy bags of chemicals.	2-20
Mental or Visual Demand	Continuous mental and visual attention required in setting up valves in lines, monitoring processes, testing samples, and reading gages and meters. Constant alertness required to detect unusual chemical reactions and take prompt action.	3-15
Responsibility Equip. & Process	Failure to detect excessive reaction temperatures in processing tanks may result in damage to tank linings. Errors in pumping material through lines not designed to handle them may result in damage to pipes, pumps, valves and other equipment. Probable damage would seldom exceed \$250.	3-15
Responsibility Material & Prod.	Probable loss in processing waste material would be negligible.	1- 5
Responsibility Safety of Others	Errors in mixing strong solutions in receiving tanks may cause violent reactions and result in severe chemical burns to others.	4-20
Responsibility Work of Others	Responsible only for own work.	1- 5
Working Conditions	Exposed to odors in varying degrees from wastes and intermittently to heat and chemical dust. Work out of doors majority of time with exposure to prevailing weather conditions.	3-30
Unavoidable Hazards	Disabling injuries from leaks in piping and associated equipment, and from accidents involving treatment of wastes.	4-20

Total
Points

280

**HOURLY JOB DESCRIPTION
PRATT & WHITNEY AIRCRAFT**

Job Title: INDUSTRIAL TRUCK OPERATOR

Dept. 32 Grade: 8 Job Code: 134.4

Duties:

U.S.E.S. Code: _____ P.W.A. Occ. Group: 800

Receive and store in an outlying area drums of industrial liquids, and deliver orders to shop departments, oil distribution centers and reclamation crib where the work requires operating both industrial and outside trucks, and individuals are rotated between inside and outside assignments on a regular schedule.

Receive drums of material at outlying storage yard and make sure that it is what the accompanying paper work calls for. Notify Leader of any discrepancies found. Operate industrial truck to unload incoming material and store in yard, racks or shed in accordance with accepted practice of using oldest material first. Segregate material that requires laboratory approval until it has been found acceptable. Fill empty drums from bulk storage tanks, attaching grounding cables to drum and storage tank or other container before pumping volatile fluids. Load materials on truck, deliver to receiving area or other destination, and obtain signature on paper work for material delivered. Pick up empty drums, and barrels and tanks of waste liquid, including pyrophoric and other hazardous materials, check tags attached to containers to see what material is in them, and deliver to proper area assigned for storing the material.

Check stacks for leaky drums, vent drums periodically, assist in taking periodic inventory by counting material on hand, stencil identification markings on drums, take samples for laboratory analysis and perform other similar tasks as required. Occasionally drain, clean, and service degreaser tanks as emergency calls are received.

Refer unusual or recurring problems to Working Leader.

cv/9

dt

Job Title: **INDUSTRIAL TRUCK OPERATOR**

Dept: 32

Grade: 8

Job Code: 134.4

FACTOR	SUBSTANTIATING DATA - HOURLY JOB RATING	DEG. PTS.
Education	Requires ability to understand and work from information pertaining to the safe method of trucking hazardous industrial liquids and other instructions pertaining to the identification and delivery of materials, and to add and subtract to assist in taking inventories and to check counts against paper work.	1-14
Experience	2 - 3 months.	1-22
Initiative and Ingenuity	Under direction of Working Leader, Industrial Liquids Storage and Distribution, follow detailed instructions in operating industrial and outside trucks to carry out a variety of trucking assignments. Exercise care in following safety regulations, operating truck through narrow aisles, crowded areas and over the road, in stacking drums and in checking loads against paper work.	2-28
Physical Demand	Most of time spent operating trucks which requires moderate effort. Tip and roll heavy drums which requires strenuous effort for short periods.	3-30
Mental or Visual Demand	Continuous mental and visual attention required to drive trucks, load, unload, stack and deliver drums to correct location, and check loads against accompanying paper work.	3-15
Responsibility Equip. & Process	Carelessness in operating trucks may cause damage to drive train, or cause collision and result in damage to vehicle. Probable damage would seldom exceed \$200.	3-15
Responsibility Material & Prod.	Carelessness in loading drums, or improper tightening of caps, may cause spilling of liquids and result in waste. Filling supply trucks with incorrect oil may cause contamination and result in waste. Probable loss would seldom exceed \$60.	2-10
Responsibility Safety of Others	Carelessness in driving trucks may cause accidents and result in permanently disabling injuries to others.	4-20
Responsibility Work of Others	Responsible only for own work.	1- 5
Working Conditions	Most of time spent in outside storage area with exposure to prevailing weather conditions. Hands and clothing become oily and dirty from working with drums of industrial liquids.	3-30
Unavoidable Hazards	Severe injuries from accidents involving heavy drums.	4-20

TOTAL POINT

209

SECTION H - CLOSURE PLAN AND FINANCIAL REQUIREMENTS

A. INTRODUCTION

This Closure Plan is provided in accordance with RCRA Regulations for all active units at the Concentrated Waste Treatment Plant (CWTP) Buildings 1 through 6. These units include five container storage areas and two tank storage areas. All of the tanks have secondary containment, however some of the ancillary piping does not. P&W has an approved partial Closure Plan for the Burn-Zol hazardous waste incinerator, and is presently in the process of implementing closure of this unit.

In addition, P&W is concurrently submitting a notification of partial closure to EPA, Region I and to the DEP, and to implement closure of the wax/solvent storage tank located in the same building as the incinerator, in the CWTP area.

The approved partial closure plan for the Burn-Zol hazardous waste incinerator is included in Appendix H-1, and the interium report on closure of this unit is included in Appendix H-2. The partial closure plan for wax/solvent storage tank is provided in Appendix H-3.

In the future P&W intends to replace some of the storage areas at the Concentrated Waste Treatment Plant. At that time P&W will submit a notification for closure of certain existing CWTP facilities.

Closure of these facilities will be performed in a manner that:

1. Minimizes the need for further maintenance, and;
2. Controls, minimizes or eliminates to the extent necessary, post-closure release of hazardous wastes to groundwater, surface water or the atmosphere.

An on-site copy of the closure plan will be maintained at the East Hartford facility until the certification of closure has been submitted to and accepted by the U.S. Environmental Protection Agency (EPA) Region I and the Connecticut Department of Environmental Protection (CTDEP). P&W will notify the EPA Regional Administrator and CTDEP Commissioner at least 45 days prior to the date final closure is expected to begin. Upon completion of closure of each area, P&W will submit a certification by both P&W and an independent registered professional engineer to the Regional Administrator and the CTDEP Commissioner that the facility has been closed in accordance with the specifications in the approved closure plan. The closure certifications will include Appendix IX test results, all other pertinent analytical data plus the final confirmation sampling results. Included also will be:

- Photographic records of the closure documenting each construction step of the closure process
- Contractors daily log
- A list of any departure from the approved plan with rationales in accordance with 40 CFR 264.112(c).

In subsequent sections, this Closure Plan provides a description of general methods to be applied and precautions to be taken in closing the hazardous waste storage facilities. Table H-1 lists the maximum waste inventory, options for ultimate or partial closure and a schedule for ultimate closure for the Concentrated Waste Treatment Plant. A summary of specific closure methods applicable to the various systems at this facility are described in detail.

B. CLOSURE REQUIREMENTS

a. General

This section provides a description of general methods to be applied and precautions to be taken in closing the hazardous waste storage areas. Table H-1 lists the maximum waste inventory, options for ultimate or partial closure, and a schedule for ultimate closure of the facility.

In order to determine the effectiveness of the closure activities, surface samples will be analyzed both before and after decontamination. A list of hazardous constituent parameters to be used in establishing the performance standard will be developed for each storage area. These clean standard parameter (CSP) lists will consist of all the 40 CFR 264, Appendix IX parameters (Appendix IX) detected during pre-decontamination sampling, and possibly certain 40 CFR 261 Appendix VIII parameters (Appendix VIII) which are not included in Appendix IX. The Appendix VIII parameters will be selected based on the potential for their presence in any given storage area. The inclusion of specific Appendix VIII parameters will be based on a review of all available information including:

- Storage records
- Waste Product Records
- Material Safety Data Sheets
- Process Information
- Waste characterization information

Prior to decontaminating storage area surfaces, the surfaces will be sampled and analyzed for all Appendix IX constituents. After decontamination, samples of each storage area surface will be analyzed for each of the

parameters on the CSP list in order to demonstrate that the cleanup criteria have been met. A clean standard for each identified parameter on the CSP list will be developed for all exposure pathways. The pathways to be addressed are:

- Direct Ingestion
- Dermal Contact

Health/risk based target standards will be established for each parameter identified and each of the above exposure pathways. The clean standards earache to be used, as specified in the Interim Final RCRA Facility Investigation (RFI) Guidance, EPA 530/SW-89-031, May 1989 is:

- Maximum contaminant levels (MCLs)
- Risk-specific doses (RSD)
- Reference doses (Rfd)
- State of Connecticut Action Levels (CTAL).

Later versions of this document may be used if available at the time of closure.

The only exceptions to this hierarchy will be if a waste constituent has and Rfd lower than its RSD, or if a CTAL is lower than EPA values. In this case the more stringent values will be used.

In order to establish the clean-up criteria for soil and air, the following performance standards will be used.

If EPA or State of Connecticut recommended exposure limits do not exist for a constituent at the time of closure, the standard will be background levels. If background values are used, they will be statistically verified. Any background values that are shown to be in excess of the health/risk based standards will not be used unless it is demonstrated that the residual constituents are truly indicative of background concentrations and not the result of waste contamination.

Background concrete samples will be collected from areas unaffected by manufacturing processes, or waste or product storage. If possible, concrete

samples will be collected from the same phase of construction as the installation of the storage areas themselves. Once the CSP list is developed, specific sample handling and analytical methods will conform to those specified in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846.

b. General Closure Requirements

1. Health and Safety - The decontamination crew will consist of a minimum of two individuals who will be adequately clothed, including self-contained breathing apparatus, if required, and coveralls. Supervision of the decontamination process will include an individual(s) responsible for operation of the TSDF.

The primary basis for the level of personnel protection selected is determined by:

- The type, toxicity, measured concentration, and permissible exposure limits of the chemical substances.
- The potential or measured exposure to substances in the air, splashes of liquids, or other direct contact with materials due to the work being performed.

The personnel protective equipment used to protect the body against chemical hazards is divided into four categories according to the degree of protection:

- Level A - Will be worn when the highest level of respiratory, skin, and eye protection is needed.
- Level B - Will be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection is needed.
- Level C - Will be worn when the types of airborne substances are known, the concentrations have been measured, and the criteria for using air-purifying respirators are met.
- Level D - This level is used where no respiratory or skin hazards are present. Level D protection is primarily a work uniform providing minimal protection.

It is not anticipated that personnel will need to use Levels A or B, although this determination will be made after the complete CSP list is developed and specific hazardous constituents are known.

2. Sudden or Non-Sudden Release, or Fire Hazard - The decontamination process will be considered as an activity presenting a high risk potential for release of hazardous waste or fire/explosion hazard. As such, the appropriate mechanisms of the Contingency Plan will be ready for activation.

3. Scheduling

Completion of closure will be within 180 days of agency approval of the closure plan or from the last receipt of hazardous wastes; whichever occurs later. The schedule for closure including milestone dates follows:

<u>DAY</u>	<u>ACTIVITY</u>
-45	Written notification of anticipated closure.
0	EPA and CTDEP approved closure plan or last receipt of hazardous wastes (if that is later).
90	All hazardous wastes disposed of off-site at permitted facilities. Tanks and appurtenances removed and disposed of off-site at permitted facilities.
100	Inspection for residual wastes complete and all damaged areas identified. Samples collected from damaged areas and analyzed appropriately.
120	Floors and equipment cleaned and rinsed. Confirmatory chip samples taken of the concrete containments and soils.
150	Floor and piping repaired and/or sealed as necessary for further use.
180	Completion of closure and certification submittal to the EPA Regional Administrator and CTDEP Commissioner.

All final closure activities will be supervised and certified by an independent registered professional engineer, in addition to P&W personnel.

P&W may require an extension of closure time depending on the season that closure begins.

4. Partial Closure - Partial closure potential for all facilities has been noted on Table H-1. The procedures described for ultimate closure would be followed for partial closure.

5. Certification - The following certification should be submitted to the EPA Region I Administrator and the Commissioner of CT DEP upon completion of closure:

"I, _____, for Pratt & Whitney, United Technologies
(Name)

Corporation, owner and operator of _____,
(Site)

a hazardous waste storage area and I, _____, P.E.,
(Name)

employed by _____, certify by means of our
(Firm)

signatures, that the facility named above has been closed in accordance with the method specified by the Closure Plan, and attached hereto.

Closure was completed on _____, after receiving the final
(Date)

volume of material on _____".
(Date)

c. Amending the Closure Plan

P&W will amend the closure plan whenever changes in operating plans or facility design affect the closure plan, or whenever there is a change in the expected year of closure. If a request for permit modification is made to authorize a change in operating procedures or facility design, P&W will also request a modification to the Closure Plan at the same time. If a permit modification is made requiring a change in operating procedures or facility design, P&W will make a request for modification of the Closure Plan within 60 days after the change in plans or design occurs.

TABLE H-1
CLOSURE PLAN SUMMARY
 CWTB
EAST HARTFORD, CONNECTICUT

<u>Item</u>	<u>Process</u>	<u>Process Code</u>	<u>Maximum Inventory</u>	<u>Closure Options</u> <u>Partial/Ultimate</u>	<u>Schedule For Ultimate Closure</u> <u>Start*/Complete</u>	<u>Year</u>
CWTP-1	Treatment Buildings: Container Storage Area	S01	61,360 gallons Total	x	April, September	1993
CWTP-2	Barrel Building: Container Storage Area	S01		x	April, September	1993
CWTP-4	Barrel/Transporter Storage Pad	S01		x	April, September	1993
CWTP-5	Storage Building A	S01	85,000 gallons Total	x	April, September	2041
CWTP-6	Storage Building B	S01		x	April, September	2041
CWTP-2	Barrel Building: Tank Storage Area	S02		x	April, September	1993
CWTP-3	Underground Oil Tanks	S02		x	April, September	1993

*Assumed start date. Completion date based on estimated time of performance of closure.

d. Closure of Container Storage Areas

This closure plan describes the procedures to be followed during closure of the following areas:

- (1) Treatment Building Container Storage Area (CWTP-1)
- (2) Barrel Building Container Storage Area (CWTP-2)
- (3) Barrel/Transporter Storage Pad (CWTP-4)
- (4) Storage Building A (CWTP-5)
- (5) Storage Building B (CWTP-6)

For these areas it is anticipated that the inventory of hazardous wastes remaining at closure will not exceed the maximum inventory value listed in Table H-1. For the purpose of this plan all the areas listed above are considered as container storage areas and are discussed jointly below. The procedures for closure of these areas are as follows:

1. Collect two composite concrete chip samples from the containment base of each unit. Each composite will be made up of several discrete samples collected from discolored, soft or otherwise damaged areas to represent worst case conditions. Each composite sample will then be analyzed for Appendix IX constituents.
2. Dispose of all remaining hazardous wastes off-site via licensed vendors for disposal at permitted TSDF's or through the on-site NPDES permitted industrial wastewater treatment system.
3. Evaluate the results of Appendix IX analyses to establish the clean standard parameter (CSP) list and identify corresponding health/risk based target standards.

4. If health/risk based standards do not exist for a specific parameter at the time of closure, a minimum of four background concrete chip samples will be collected and analyzed for the CSP list. This data will be used for comparison in the absence of health/risk based standards.
5. A Health and Safety Plan, specific to the site being closed and the CSP list, will be prepared to cover the closure activities to be performed.
6. The containment areas will then be scrubbed with the appropriate decontamination solution depending on the type(s) of hazardous waste stored in the area, and thoroughly rinsed with water. A summary of recommended decontamination solutions for various types of hazardous wastes along with the formulations of the decontamination solutions is provided in Table H-2.

Spent decontamination solutions and rinsewaters will be collected in existing floor sumps or will be contained through the use of dikes to prevent wash water from migrating into clean areas. This rinsate will be collected using a wet/dry vacuum then collected and discharged to the NPDES permitted industrial wastewater treatment system.
7. All equipment used in closure activities will either be decontaminated or collected and disposed of as hazardous waste. Small manual tools will be decontaminated using an industrial grade non-phosphate detergent and water solution. Equipment used during decontamination, such as brushes, gloves, disposable suits, etc., will be collected in a 55-gallon drum and disposed

TABLE H-2
CLEANER SOLUTION FORMULATIONS

- DECON SOLUTION A - A solution containing 5 percent sodium carbonate (Na_2CO_3) and 5 percent trisodium phosphate (Na_3PO_4).
To 10 gallons of water, add 4 pounds of sodium carbonate (soda ash) and 4 pounds of trisodium phosphate. Stir until evenly mixed.
- DECON SOLUTION B - A solution containing 10 percent calcium hypochlorite ($\text{Ca}(\text{ClO})_2$).
To 10 gallons of water, add 8 pounds of calcium hypochlorite. Stir with a wooden or plastic stirrer until evenly mixed.
- DECON SOLUTION C - A solution containing 5 percent trisodium phosphate. This solution can also be used as a general purpose rinse.
To 10 gallons of water, add 4 pounds of trisodium phosphate. Stir until evenly mixed.
- DECON SOLUTION D - A dilute solution of hydrochloric acid (HCl)
To 10 gallons of water, add 1 pint of concentrated hydrochloric acid. Stir with a wooden or plastic stirrer.

TYPE OF HAZARDOUS WASTE

PREFERRED DECONTAMINATION SOLUTION

Inorganic acids, metal processing wastes	A
Heavy metals, i.e., mercury, lead, cadmium	A
Pesticides, fungicides, chlorinated phenols, dioxins, PCPs	B
Cyanides, ammonia, and other non-acidic inorganic wastes	B
Solvents and organic compounds, such as trichloroethylene, chloroform, and toluene	C, A
PBBs and PCBs	C, A
Oily, greasy, unspecified wastes	C
Inorganic bases, alkali, and caustic waste	D

of as hazardous waste using licensed transporters and permitted disposal facilities. Portions of larger tools (i.e. lifts, hoists) which have come in contact with the waste will be decontaminated by steam cleaning. All rinsate generated during decontamination activities will be collected and discharged to the NPDES permitted industrial wastewater treatment system.

8. Once decontamination has been completed as described above, the container storage area will be inspected for cracks or other visible signs of deterioration. If cracks or deteriorated areas are observed then the sampling plan discussed below will be modified to include a representative portion of these areas. For container storage areas that include sumps, one of the samples will be collected from the bottom of the sump.
9. If no cracks, or visible signs of deterioration are found, then non-statistical "judgement sampling" of potentially contaminated areas, based on visual observations, is not possible. Instead, verification sampling will be performed according to the following procedure.

Each of the areas, after decontamination, will be gridded and sampled at locations corresponding to randomly selected grid nodes. The size of the grid interval is determined by this generally accepted mathematical formula:

$$GI = (A/3.14)^{0.5}/2, \text{ where:}$$

GI = grid interval, ft

A = area to be gridded, sq. ft.

The calculated value for the grid interval is then rounded off to the nearest integer and the container storage area is gridded.

The number of samples (n) to be obtained from each slab is determined by the square root of the number of grid nodes.

A random number table or generator is typically used to determine which grid nodes or grid areas will be sampled.

Table H-3 outlines the calculations of the number of verification samples required to be collected from each storage area to generate statistically viable data according to the procedure outlined above. The number of grid samples is the number of samples statistically required. A random number table procedure was used to calculate the exact location of these samples, which are shown on Figure H-1 for each of the container storage areas. In addition to these samples, each containment sump will be sampled, raising the number of samples to be collected to the value shown in the last column of Table H-3. The locations of the containment sumps are also shown on Figure H-1.

All samples will consist of concrete chip samples collected with an air chisel or concrete drill. The portion of the tool in direct contact with the concrete will be cleaned between samples using an industrial non-phosphate detergent wash and a tap water rinse.

The resulting concrete chips will be transferred directly into laboratory supplied glassware. The field QA/QC program for

TABLE H-3
CONTAINER STORAGE AREAS
VERIFICATION SAMPLING

<u>Item</u>	<u>Process</u>	<u>Area</u> <u>(Sq. Ft.)</u>	<u>Grid</u> <u>Interval(Ft)</u>	<u>No. of</u> <u>Grid Nodes</u>	<u>No. of</u> <u>Grid Samples</u>	<u>No. of</u> <u>Sump Samples</u>	<u>Total</u> <u>No. of</u> <u>Samples</u>
CWTP-1	Treatment Building Container Storage Area	450	6	20	4	1	5
CWTP-2	Barrel Building Container Storage Area	3306	16	25	5	6	11
CWTP-4	Barrel/Transporter Storage Pad	900	8	27	5	1	6
CWTP-5	Storage Building A	3822	17	24	5	3	8
CWTP-6	Storage Building B	1794	12	21	4	3	7

FIGURE H-1
SAMPLING LOCATIONS

**US EPA New England
RCRA Document Management System
Image Target Sheet**

RDMS Document ID # 3961

Facility Name: PRATT & WHITNEY - MAIN STREET

Facility ID#: CTD990672081

Phase Classification: R-1B

Purpose of Target Sheet:

☒ **Oversized** (in Site File) ☐ **Oversized** (in Map Drawer)

☐ **Page(s) Missing** (Please Specify Below)

☐ **Privileged** ☐ **Other** (Provide
Purpose Below)

Description of Oversized Material, if applicable:

DRAWING H-1: SAMPLING LOCATIONS

☒ **Map** ☐ **Photograph** ☐ **Other** (Specify Below)

*** Please Contact the EPA New England RCRA Records Center to View This Document ***

concrete chip samples will include one duplicate for every 10 samples and one trip blank to accompany the samples to the laboratory. Immediately following sample collection, each sample will be labeled and placed in an iced cooler. The samples will be transported under full chain-of-custody to a State of Connecticut approved laboratory.

The analytical testing and determination procedures are presented in Section C of this Closure Plan.

10. If based on an evaluation of the analytical data (comparison to available health/risk based levels or background) the decontamination effects are deemed incomplete, the decontamination will be repeated until follow-up sampling demonstrates that parameters are at or below health/risk standards or are consistent with background levels. Any concrete chip sampling areas which exhibit levels consistent with background and either above or below health/risk levels will be considered representative of ambient background levels thus decontamination efforts will be deemed complete unless it is determined that background samples have been contaminated with the waste.
11. Complete the certification of closure as presented in Section B(b)(5) of this Closure Plan. Within 60 days of completion of all closure activities, the Certification of Closure will be sent by registered mail to the EPA Regional Administrator and the Commissioner of the Connecticut Department of Environmental Protection.

e. Closure of Tank Storage Areas

This section describes the procedures to be followed for closure of the tank storage areas which include the following:

- (i) Barrel Building Tank Storage Area (CWTP-2)
- (ii) Underground Oil Tanks (CWTP-3)

The barrel building tank storage area consists of eight above ground tanks with secondary containment and several secondary containment areas for ancillary equipment and loading/unloading stations. The second tank storage area consists of three double wall underground storage tanks with a leak detection system and above ground piping. For each of these areas it is anticipated that the inventory of hazardous wastes remaining at closure will not exceed the maximum inventory value listed in Table H-1. For the purpose of this plan all the areas listed above are considered as tank storage areas and are discussed jointly below. The underground tanks are double wall tanks. Therefore, verification sampling will not be required at closure for the UST's as long as the leak detection system remains functional and a leak has not been detected. (Steps 1 through 4, 8, and 10 through 12 do not apply to the UST's).

The procedures for closure of tank storage areas are as follows:

1. Collect two composite concrete chip samples from the containment base of each tank and ancillary equipment containment structure. Each composite will be made up of several discrete samples collected from discolored, soft or otherwise damaged areas to represent worst case conditions. Each composite sample will then be analyzed for Appendix IX constituents.

2. Dispose of all remaining hazardous wastes off-site via licensed vendors for disposal at permitted TSDF's or through the on-site NPDES permitted industrial wastewater treatment system.
3. Evaluate the results of Appendix IX analyses to establish the clean standard parameter (CSP) list and identify corresponding health/risk based target standards.
4. If health/risk based standards do not exist for a specific parameter at the time of closure, a minimum of four background concrete chip samples will be collected and analyzed for the CSP list.
5. A Health and Safety Plan, specific to the site being closed, and the CSP List, will be prepared to cover the closure activities to be performed.
6. Once all hazardous waste inventory has been removed, all underground waste feed lines will be decontaminated by flushing with the appropriate decontamination solution and then thoroughly rinsed with tap water. After the third rinse the rinsate will be collected and tested for the CSP List. If the rinsate is found to be hazardous, then an additional two-step rinsing procedure will be implemented. The first rinse will consist of a non-hazardous biodegradable degreaser and water solution. This will be followed by a potable water rinse. The rinsate from the second rinse will be collected and tested as above to determine if it is hazardous. If the rinsate is hazardous then the two-step rinsing process will be repeated until the plant tap water rinse is determined to be non-hazardous. All rinsate will

be collected and discharged to the NPDES permitted industrial wastewater treatment system. The plant tap water will also be analyzed for the CSP list.

7. All above ground and easily accessible underground piping will be removed and disposed of as non-hazardous waste after decontamination. The tank itself and any tank components which have not been decontaminated will either be decontaminated, dismantled and disposed of as non-hazardous waste as described above, or dismantled and disposed of as a hazardous waste without prior decontamination. The cost estimate, presented in Section D of this Closure Plan is based on the assumption that the tank components will be removed and disposed of off-site as hazardous waste.

Disassembly will consist of manual dismantling and/or the use of powered equipment. The option is available to use both hot or cold cutting techniques. The size of stockpiled components will be directly influenced by the disposal facilities requirements for landfilling. It is anticipated that all piping will be cut into four foot sections and that larger components will not exceed 10 feet in any dimension.

8. After removal of the tank components, as described above, the floor of the concrete containment area will then be scrubbed with the appropriate decontamination solution depending on the type(s) of hazardous waste stored in the area, and then thoroughly rinsed with water. A summary of recommended decontamination solutions for various types of hazardous wastes

along with the formulations of the decontamination solutions has been provided in Table H-2. The containment area for CWTP-2 includes the tanker pads, sumps, overflow tank, the transporter dump stations and the pump room in the basement. The dump station servicing CWTP-3 would also be included.

Spent decontamination solutions or rinsewaters will be collected in existing floor sumps or will be contained through the use of dikes to prevent washwater migrating into clean areas. This rinsate will be collected using a wet/dry vacuum then discharged to the NPDES permitted industrial wastewater treatment system.

9. All equipment used in closure activities will either be decontaminated or collected and disposed of as hazardous waste. Small manual tools will be decontaminated using an industrial grade non-phosphate detergent and water solution. Equipment used during decontamination, such as brushes, gloves, disposable suits, etc., will be collected in a 55-gallon drum and disposed of as hazardous waste using licensed transporters and permitted disposal facilities. Portions of larger tools (i.e. lifts, hoists) which have contacted the waste will be decontaminated by steam cleaning. All rinsate generated during decontamination activities will be collected and discharged to the NPDES permitted industrial wastewater treatment system.
10. Once decontamination has been completed as described above, the tank storage area containments will be inspected for cracks or other visible signs of deterioration. If cracks or deteriorated areas are observed, then the sampling plan presented below will

be modified to include a representative portion of these areas. Containment sumps will be sampled in addition to the samples discussed above. If no cracks or other visible signs of deterioration are found, then non-statistical "judgement sampling" of potentially contaminated areas, based on visual observations, is not possible. Instead, verification sampling will be performed according to the following procedure:

Each of the areas, after decontamination, will be gridded and sampled at locations corresponding to randomly selected grid nodes. The size of the grid interval is determined by this generally accepted mathematical formula:

$$GI = (A/3.14)^{0.5}/2, \text{ where:}$$

GI = grid interval, ft

A = area to be gridded, sq. ft.

The calculated value for the grid interval is then rounded off to the nearest integer and the tank containments are gridded.

The number of samples to be obtained from each slab is determined by the square root of the number of grid nodes.

A random number table or generator is typically used to determine which grid nodes or grid areas will be sampled.

Table H-4 outlines the calculations of the number of verification samples required to be collected from the Barrel Building, Tank Storage Area. No sampling is required for the

TABLE H-4
 CLOSURE OF TANK STORAGE AREAS
 VERIFICATION SAMPLING

Item	Process	Area (Sq. Ft.)	Grid Interval	No. of Grid Nodes	No. of Grid Samples	No. of Sump Samples	Total No. of Samples
CWTP-2	Barrel Building Tank Storage Area	1110	9	24	5	1	6
	Barrel Building Truck Containment Pad AND Containment Tank	1800	12	20	4	3	7
		112	3	20	4	-	4
CWTP-3	Underground Oil Tanks						NA*

NA: Not Applicable

* No sampling required for these double walled tanks (secondary containment) equipped with a leak detection system.

three underground oil tanks (CWTP-3) since secondary containment requirements for this system are met by the utilization of a double wall tank with an intersititial monitoring system assuming that this system has remained operational and a leak has not been detected.

The number of grid samples is the number of samples statistically required. A random number table procedure was used to calculate the exact locations of these samples, which are shown on Figure H-1. In addition to these samples, the containment sumps will be sampled, raising the number of samples to be collected to the value shown in the last column of Table H-4. The locations of the containment sumps are also shown on Figure H-1. In addition, soil samples will be collected and analyzed from trenches created by the removal of underground pipes at CWTP-2.

All other samples will consist of concrete chip samples collected with an air chisel or concrete drill. The portion of the tool in direct contact with the concrete will be cleaned between samples using an industrial non-phosphate detergent wash and a potable water rinse.

The resulting concrete chips will be transferred directly into laboratory supplied glassware. The field QA/QC program for concrete chip samples will consist of one field duplicate for every 10 samples and one trip blank to accompany the samples to the laboratory. Immediately following sample collection, each sample will be labeled and placed in an iced cooler. The samples will be transported under full chain-of-custody to a State of Connecticut certified laboratory.

The analytical testing and determination procedures are presented in Section C of the Closure Plan.

12. If based on an evaluation of the analytical data (comparison to available health/risk based levels and background), the decontamination process is deemed incomplete, the decontamination will be repeated until follow-up sampling demonstrates that parameters are at or below health/risk standards or are consistent with background levels. Any concrete chip sampling areas which exhibit levels consistent with background and either above or below health/risk levels will be considered representative of ambient background levels thus decontamination efforts will be deemed complete unless background samples are deemed to be contaminated by the waste.
11. Complete the certification of closure as presented in Section B(b) (5) of this Closure Plan. Within 60 days of completion of all closure activities, the Certification of Closure will be sent by registered mail to the EPA Regional Administrator and the Commissioner of the Connecticut Department of Environmental Protection.

C. LABORATORY ANALYSIS AND DATA EVALUATION

The analytical methods used will for analysis of concrete samples will be those described in the latest edition of EPA Publication SW-846 - Test Methods for Evaluating Solid Waste. The designated laboratory will follow all applicable internal QA/QC procedures outlined in SW-846.

Upon receipt of the analytical data, an initial evaluation of the

results will be performed through data validation. Data validation includes a review of field QA/QC procedures (i.e. trip blanks, field duplicates) and laboratory QA/QC procedures (i.e. holding times, blind duplicate analysis, surrogate recoveries). Data points that are not adequately supported by the QA/QC procedures will be referred to the sampling team and/or the laboratory for appropriate corrective actions.

Upon completion of data validation, the results will be compared to background data points and the relevant and appropriate regulatory standards and criteria. An explanation of how this will be performed is presented below.

Data Evaluation

As previously stated, decontamination of the storage areas will be demonstrated complete by concrete chip sampling and comparison to regulatory and background levels.

Test results will be compared to the Health/Risk based target standards specified in the interim final RCRA Facility Guidance (EPA-530/SW-89-031). If any parameter exceeds the applicable target standard, then decontamination will be deemed incomplete in the area of that sample. Decontamination efforts will continue until follow-up sample data achieves the applicable target standard.

For constituents for which a health/risk based standard is not available, comparison will be made to background data. The analytical results of these samples will be statistically analyzed using Cochran's

approximation to the Behrens-Fisher Students' T-Test (40 CFR Part 264, Appendix IV). If the reported concentration of a specific constituent is the method detection limit, the numerical value of the method detection limit will be used in calculations. The mean and variance of the background samples will be used to determine if clean standard verification samples contain significant constituent concentrations at a 95 percent confidence level. If any parameter exceeds the corresponding background level, decontamination will be considered incomplete in the area of that sample. Decontamination efforts will continue until follow-up sample data achieves the corresponding background level.

D. MAXIMUM CLOSURE COST ESTIMATE

Maximum closure costs for all of the storage areas are estimated to be \$1,680,120 in 1990 dollars. A breakdown of the costs is included in Table H-5. All costs assume performance of closure activities by a qualified third-party contractor. The estimates assume that the maximum waste inventory will be present at closure.

The closure cost estimate will be revised whenever a change in the closure plan affects the cost of closure. The closure cost will be adjusted annually as described in 40 CFR 264.14(b).

E. FINANCIAL ASSURANCE

The required financial assurances for closure and pollution liability coverage are presented in Exhibit H-1 in the following order:

- A letter from UTC's Executive Vice President and Chief Financial Officer, John A. Rolls, transmitting financial documentation to the DEP, dated March 29, 1980 including Exhibit A.

TABLE H-5

MAXIMUM CLOSURE COST ESTIMATE

TABLE H-5
MAXIMUM CLOSURE COST ESTIMATE

ACTIVITY DESCRIPTION	CWTP-1 (CONTAINERS)	CWTP-2 (CONTAINERS)	CWTP-2 (TANKS)	CWTP-3 (TANKS)	CWTP-4 (CONTAINERS)	CWTP-5 (CONTAINERS)	CWTP-6 (CONTAINERS)	TOTAL
INITIAL SAMPLING & ANALYSIS	\$12,000.00	\$12,000.00	\$60,000.00	N/A	\$12,000.00	\$12,000.00	\$12,000.00	\$120,000.00
REMOVE & DISPOSE OF REMAINING WASTE (1)	\$50,000.00	\$350,000.00	\$35,000.00	\$20,000.00	\$75,000.00	\$150,000.00	\$75,000.00	\$755,000.00
BACKGROUND SAMPLING & ANALYSIS	\$4,000.00	\$4,000.00	\$20,000.00	N/A	\$4,000.00	\$4,000.00	\$4,000.00	\$40,000.00
HEALTH & SAFETY	\$3,000.00	\$3,000.00	\$3,000.00	\$3,000.00	\$3,000.00	\$3,000.00	\$3,000.00	\$21,000.00
DECONTAMINATE BURIED PIPING	N/A	N/A	\$5,000.00	N/A	N/A	N/A	N/A	\$5,000.00
DISMANTLE AND DISPOSE OF ABOVEGROUND TANKS AND ANCILLARY EQUIPMENT (EXCLUDING UNDERGROUND PIPE)	N/A	N/A	\$120,000.00	N/A	N/A	N/A	N/A	\$120,000.00
REMOVE AND DISPOSE OF UNDERGROUND DOUBLE WALL TANKS	N/A	N/A	N/A	\$80,000.00	N/A	N/A	N/A	\$80,000.00
REMOVE AND DISPOSE OF ACCESSIBLE UNDERGROUND PIPE	N/A	N/A	\$20,000.00	N/A	N/A	N/A	N/A	\$20,000.00
DECONTAMINATE CONCRETE CONTAINMENTS	\$3,000.00	\$15,000.00	\$40,000.00	N/A	\$6,000.00	\$40,000.00	\$20,000.00	\$124,000.00
COLLECT AND ANALYZE CONFIRMATORY SAMPLES	\$4,000.00	\$8,000.00	\$12,000.00	N/A	\$5,000.00	\$6,000.00	\$6,000.00	\$41,000.00
REMOVE AND DISPOSE OF CONTAMINATED CONCRETE (2)	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$10,000.00	\$70,000.00
DATA EVALUATION & CLOSURE CERTIFICATION	\$2,000.00	\$5,000.00	\$15,000.00	\$5,000.00	\$3,000.00	\$5,000.00	\$5,000.00	\$40,000.00
SUBTOTAL	\$88,000.00	\$407,000.00	\$340,000.00	\$118,000.00	\$118,000.00	\$230,000.00	\$135,000.00	\$1,436,000
INSURANCE (7%)	\$6,160.00	\$28,490.00	\$23,800.00	\$8,260.00	\$8,260.00	\$16,100.00	\$9,450.00	\$100,520.00
CONTINGENCY (10%)	\$8,800.00	\$40,700.00	\$34,000.00	\$11,800.00	\$11,800.00	\$23,000.00	\$13,500.00	\$143,600.00
TOTAL	\$102,960.00	\$476,190.00	\$397,800.00	\$138,060.00	\$138,060.00	\$269,100.00	\$157,950.00	\$1,680,120.00

(1) ASSUME MAXIMUM INVENTORY PRESENT AT CLOSURE

(2) ALLOWANCE FOR REMOVAL AND DISPOSAL OF CONTAMINATED CONCRETE (20 TONS)

- A special report by Price Waterhouse, independent Certified Public Accountants, dated March 28, 1990.
- Letters from UTC's Manager of Regulatory Affairs, John E. Szwest to the EPA, Region I, Regional Administrator, dated March 29, 1990 and to CIDEF also dated, March 29, 1990.
- UTC Annual Report 1989.

RCRA Part B Permit Application
United Technologies
Pratt & Whitney
CID 990672081

Page 120 of 125
November 12, 1990

EXHIBIT H-1
FINANCIAL ASSURANCE DOCUMENTATION

March 27, 1990

CERTIFIED MAIL

Connecticut Department of Environmental Protection
Hazardous Waste Management Section
165 Capitol Avenue
Hartford, CT 06106

Dear Sir:

I am the chief financial officer of United Technologies Corporation, United Technologies Building, Hartford, CT 06101. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure and/or post-closure care as specified in Subpart H of 40 CFR Parts 264 and 265.

The firm identified above is the owner or operator of the following facilities which are located in the State of Connecticut for which liability coverage for both sudden and nonsudden accidental occurrences is being demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265:

See Exhibit A attached hereto. Facilities of the Corporation are designated "division."

The firm identified above guarantees, through the guarantee specified in Subpart H of 40 CFR Parts 264 and 265, liability coverage for sudden occurrences at the following facilities owned or operated by the following: Norden Systems, Inc. of Norden Place, Norwalk, Connecticut - CTDO89623318 and International Fuel Cell Corporation of South Windsor, Connecticut - CTD010166791. The firm identified above is the direct or higher-tier parent corporation of the owners or operators.

1. The firm identified above owns or operates the following facilities which are located in the State of Connecticut for which financial assurance for closure or post-closure care or liability coverage is demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure and/or post-closure cost estimates covered by the test are shown for each facility:

See Exhibit A attached hereto. Facilities of the Corporation are designated "division."

2. The firm identified above guarantees, through the guarantee specified in Subpart H of 40 CFR Parts 264 and 265, the closure and post-closure care of the following facilities owned or operated by the guaranteed party. The current cost estimates for the closure or post-closure care so guaranteed are shown for each facility:

See Exhibit A attached hereto. Facilities of subsidiaries are designated "subsidiary."

3. In States where EPA is not administering the financial requirements of Subpart H of 40 CFR Parts 264 or 265, this firm is demonstrating financial assurance for the closure or post-closure care of the following facilities through the use of a test equivalent or substantially equivalent to the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure or post-closure cost estimates covered by such a test are shown for each facility.

For the following authorized states, see Exhibit A for a list of facilities in:

California
Colorado
Florida
Maine
Mississippi
New York

4. The firm identified above owns or operates the following hazardous waste management facilities for which financial assurance for closure or, if a disposal facility, post-closure care, is not demonstrated either to EPA or a State through the financial test or any other financial assurance mechanisms specified in Subpart H of 40 CFR Parts 264 and 265 or equivalent or substantially equivalent State mechanisms. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility:

- None

5. This firm is the owner or operator of the following UIC facilities for which financial assurance for plugging and abandonment is required under Part 144. The current closure cost estimates as required by 40 CFR 144.62 are shown for each facility:

- None

This firm is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

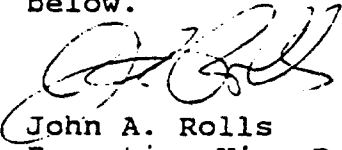
The fiscal year of this firm ends on December 31. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year, ended December 31, 1989.

Part B. Closure or Post-Closure Care and Liability Coverage

Alternative II

- | | |
|---|--|
| 1. Sum of current closure and post-closure cost estimates | \$ 12,571,067 |
| 2. Amount of annual aggregate liability coverage to be demonstrated | \$ 28,000,000 |
| 3. Sum of lines 1 and 2 | \$ 40,571,067 |
| 4. Current bond rating of most recent issuance and name of rating service | Standard & Poor's
AA
Moody's - Aa3 |
| 5. Date of issuance of bond | Nov. 15, 1989 |
| 6. Date of maturity of bond | Nov. 15, 2019 |
| *7. Tangible net worth | \$3,382,600,000 |
| *8. Total assets in the U.S. | \$9,255,700,000 |
| 9. Is line 7 at least \$10 million? | Yes |
| 10. Is line 7 at least 6 times line 3? | Yes |
| *11. Are at least 90% of the firm's assets located in the U.S.? | No |
| 12. Is line 8 at least 6 times line 3? | Yes |

I hereby certify that the wording of this letter is identical to the wording specified in 40 CFR 264.151(g) (except that references have been made to facilities located in the State of Connecticut) as such regulations were constituted on the date shown immediately below.


John A. Rolls
Executive Vice President
and Chief Financial Officer
United Technologies Corporation
Date: March 27, 1990

UNITED TECHNOLOGIES CORPORATION
HAZARDOUS WASTE MANAGEMENT AND UTC FACILITY
CLOSURE AND POST-CLOSURE CARE COSTS INFLATED FOR YEAR 1989
AND APPLICABLE COST REVISIONS BY STATE

(RCRA PARTS 264 AND 265 SUBPART H)

DATE: 03/20/90
PAGE: 1

* * * CLOSURE COSTS * * *
EXHIBIT A

STATE: CALIFORNIA

FACILITY NAME: CHEMICAL SYSTEMS DIVISION/COYOTE CENTER (DIVISION)

ADDRESS: 600 METCALF ROAD

SAN JOSE, CA 95138

U.S. EPA I.D.: CAD001705235

FACILITY TYPE: STORAGE & TREATMENT (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/
U.S. EPA REGION: DHS

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	165,000	
1982		360,000	REVISION
1983	1.060	360,000	
1984	1.040	374,400	
1985		592,000	REVISION
1986	1.030	609,760	
1987		309,000	REVISION
1988		634,360	REVISION
1989		1,102,460	REVISION

FACILITY NAME: HAMILTON STANDARD HSS O&R FACILITY (DIVISION)

ADDRESS: 4401 DONALD DOUGLAS DRIVE

LONG BEACH, CA 90808

U.S. EPA I.D.: CAD044433613

FACILITY TYPE: STORAGE & TREATMENT

STATE AGENCY/
U.S. EPA REGION: DHS

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	4,000	
1982	1.090	4,360	
1983	1.060	4,622	
1984	1.040	4,807	
1985		35,000	REVISION
1986	1.030	36,050	
1987	1.030	37,131	
1988	1.037	38,505	
1989	1.038	39,968	

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 2 EXHIBIT A

TOTAL COST IN 1989 FOR CALIFORNIA

\$ 1,142,428

STATE: COLORADO

RY) FACILITY NAME: UNITED TECHNOLOGIES MICROELECTRONICS CENTER, INC. (SUBSIDIARY)

ADDRESS: 1575 GARDEN OF THE GODS ROAD

COLORADO SPRINGS, CO 80907

U.S. EPA I.D.: COD000716597

FACILITY TYPE: STORAGE

STATE AGENCY/
U.S. EPA REGION: CDH

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	14,360	
1982		19,632	REVISION
1983		38,000	REVISION
1984	1.040	39,520	
1985	1.040	41,101	
1986	1.030	42,335	
1987	1.030	43,605	
1988	1.037	45,218	
1989	1.038	46,936	

TOTAL COST IN 1989 FOR COLORADO

\$ 46,936

STATE: CONNECTICUT

FACILITY NAME: HAMILTON STANDARD COMPLEX B-1, 2 AND 3 (DIVISION)

ADDRESS: HAMILTON ROAD

WINDSOR LOCKS, CT 06096

U.S. EPA I.D.: CTD001145341

FACILITY TYPE: STORAGE & TREATMENT (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/
U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	580,000	
1982	1.090	632,200	
1983	1.060	670,132	
1984	1.040	696,937	
1985		686,073	REVISION
1986		707,335	REVISION
1987	1.030	728,555	
1988		546,676	REVISION
1989	1.038	567,450	

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 3 EXHIBIT A

FACILITY NAME: INTERNATIONAL FUEL CELL CORPORATION (SUBSIDIARY)

ADDRESS: P.O. BOX 739

SOUTH WINDSOR, CT 06070

U.S. EPA I.D.: CTD010166791

FACILITY TYPE: STORAGE

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	6,450	
1982	1.090	7,031	
1983	1.060	7,453	
1984	1.040	7,751	
1985	1.040	8,061	
1986	1.030	8,303	
1987	1.030	8,552	
1988		209,585	REVISION
1989	1.038	217,549	

FACILITY NAME: NORDEN SYSTEMS, INC. (SUBSIDIARY)

ADDRESS: NORDEN PLACE

NORWALK, CT 06856

U.S. EPA I.D.: CTD089623318

FACILITY TYPE: STORAGE & TREATMENT

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>
1981	1.000	12,250
1982	1.090	13,353
1983	1.060	14,154
1984	1.040	14,720
1985	1.040	15,309
1986	1.030	15,769
1987	1.030	16,242
1988	1.037	16,843
1989	1.038	17,483

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: 400 MAIN STREET

EAST HARTFORD, CT 06108

U.S. EPA I.D.: CTD990672081

FACILITY TYPE: STORAGE & TREATMENT

STATE AGENCY/

U.S. EPA REGION:

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>
-------------	-------------------------	-------------

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
 PAGE: 4 EXHIBIT A

1981		290,000	REVISION
1982		316,100	REVISION
1983		335,066	REVISION
1984		348,469	REVISION
1985	1.040	362,408	
1986	1.030	373,281	
1987	1.030	384,479	
1988	1.037	398,705	
1989	1.038	413,856	

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: AIRCRAFT ROAD

MIDDLETOWN, CT 06457

U.S. EPA I.D.: CTD003935905

FACILITY TYPE: STORAGE & DISPOSAL (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/
 U.S. EPA REGION: DEP

YEAR	INFLATION FACTOR	COST	
1981	1.000	280,000	
1982	1.090	305,200	
1983	1.060	323,512	
1984		977,080	REVISION
1985		1,688,004	REVISION
1986		2,978,000	REVISION
1987		835,000	REVISION
1988	1.037	865,895	
1989	1.038	898,799	

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: 415 WASHINGTON AVENUE

NORTH HAVEN, CT 06473

U.S. EPA I.D.: CTD001449511

FACILITY TYPE: STORAGE (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/
 U.S. EPA REGION: DEP

YEAR	INFLATION FACTOR	COST	
1981	1.000	480,000	
1982	1.090	523,200	
1983	1.060	554,592	
1984		584,982	REVISION
1985	1.040	608,381	
1986	1.030	626,633	
1987	1.030	645,432	
1988		186,060	REVISION
1989	1.038	193,130	

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 5 EXHIBIT A

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: AIRCRAFT ROAD (MANUFACTURING)

SOUTHINGTON, CT 06489

U.S. EPA I.D.: CTD001149277

FACILITY TYPE: STORAGE (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	60,000	
1982	1.090	65,400	
1983	1.060	69,324	
1984	1.040	72,097	
1985	1.040	74,981	
1986	1.030	77,231	
1987	1.030	79,548	
1988		259,000	REVISION
1989	1.038	268,842	

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: PINE STREET

MANCHESTER, CT 06040

U.S. EPA I.D.: CTD00844324

FACILITY TYPE: STORAGE

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	4,500	
1982	1.090	4,905	
1983	1.060	5,199	
1984	1.040	5,407	
1985	1.040	5,623	
1986	1.030	5,792	
1987	1.030	5,966	
1988		87,400	REVISION
1989		22,308	REVISION

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: PENT ROAD (WILLGOOS)

EAST HARTFORD, CT 06108

U.S. EPA I.D.: CTD000845131

FACILITY TYPE: STORAGE

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	3,000	
1982	1.090	3,270	

*** * * CLOSURE COSTS (CONT.) * * ***
EXHIBIT A

REVISION

ADDRESS: COLT STREET

U.S. EPA I.D.: CTD000844399

STATE AGENCY/
U.S. EPA REGION: DEP

REVISION

ADDRESS: BELAMOSE AVENUE

U.S. EPA I.D.: CTD0000844407

STATE AGENCY/
U.S. EPA REGION: DEP

REVISION

ADDRESS: NEWELL STREET (O.R.C.)

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 7 EXHIBIT A

SOUTHINGTON, CT 06489

U.S. EPA I.D.: CTD000844332

FACILITY TYPE: STORAGE & TREATMENT (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	115,000	
1982	1.090	125,350	
1983	1.060	132,871	
1984	1.040	138,186	
1985	1.040	143,713	
1986		226,405	REVISION
1987		213,945	REVISION
1988	1.037	221,861	
1989	1.038	230,292	

FACILITY NAME: SIKORSKY AIRCRAFT (DIVISION)

ADDRESS: 6900 MAIN STREET

STRATFORD, CT 06601-1381

U.S. EPA I.D.: CTD001449784

FACILITY TYPE: STORAGE & TREATMENT (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	145,000	
1982	1.090	158,050	
1983	1.060	167,533	
1984	1.040	174,234	
1985	1.040	181,203	
1986	1.030	186,640	
1987		451,000	REVISION
1988	1.037	467,687	
1989		50,000	REVISION

FACILITY NAME: SIKORSKY AIRCRAFT BRIDGEPORT PLANT (DIVISION)

ADDRESS: SOUTH AVENUE

BRIDGEPORT, CT 06604

U.S. EPA I.D.: CTD001449735

FACILITY TYPE: STORAGE

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>
1981	1.000	17,000
1982	1.090	18,530
1983	1.060	19,642
1984	1.040	20,428

DATE: 03/20/90
PAGE: 8

1985	1.040	21,245
1986	1.030	21,883
1987	1.030	22,539
1988	1.037	23,373
1989		75,000

FACILITY NAME: UNITED TECHNOLOGIES RESEARCH CENTER (DIVISION)

ADDRESS: SILVER LANE

EAST HARTFORD, CT 06108

U.S. EPA I.D.: CTD095532131
FACILITY TYPE: STORAGE

STATE AGENCY/
U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>
1981	1.000	10,000
1982	1.090	10,900
1983	1.060	11,554
1984	1.040	12,016
1985	1.040	12,497
1986	1.030	12,872
1987	1.030	13,258
1988	1.037	13,749
1989	1.038	14,271

TOTAL COST IN 1989 FOR CONNECTICUT

\$ 3,267,794

 STATE: FLORIDA

FACILITY NAME: PRATT & WHITNEY AIRCRAFT (DIVISION)

ADDRESS: P.O. BOX 2691

WEST PALM BEACH, FL 33402

U.S. EPA I.D.: FLD001447952
FACILITY TYPE: STORAGE & TREATMENT

STATE AGENCY/
U.S. EPA REGION: DER

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981		533,000	REVISION
1982		580,970	REVISION
1983		615,828	REVISION
1984		596,437	REVISION
1985		634,126	REVISION
1986		1,333,057	REVISION
1987	1.030	1,373,049	
1988	1.037	1,423,852	
1989	1.038	1,477,958	

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 9 EXHIBIT A

FACILITY NAME: PRATT & WHITNEY AIRCRAFT (DIVISION)

ADDRESS: P.O. BOX 2691

WEST PALM BEACH, FL 33402

U.S. EPA I.D.: UD 50-081415

FACILITY TYPE: UNDERGROUND INJ. CONTROL FAC. (FLA NON-RCRA REQUIREMENT)

STATE AGENCY/

U.S. EPA REGION: DER

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>
1981	1.000	0
1982	1.090	0
1983	1.060	0
1984	1.040	0
1985	1.040	100,000
1986	1.030	103,000
1987	1.030	106,090
1988	1.037	110,015
1989	1.038	114,196

TOTAL COST IN 1989 FOR FLORIDA

\$ 1,592,154

STATE: MAINE

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: P.O. BOX 455

NORTH BERWICK, ME 03906

U.S. EPA I.D.: MED000791681

FACILITY TYPE: STORAGE

STATE AGENCY/

U.S. EPA REGION: DEP

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	60,000	
1982		40,000	REVISION
1983	1.060	42,400	
1984		112,000	REVISION
1985	1.040	116,480	
1986	1.030	119,975	
1987	1.030	123,574	
1988	1.037	128,146	
1989	1.038	133,016	

TOTAL COST IN 1989 FOR MAINE

\$ 133,016

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 10 EXHIBIT A

STATE: MISSISSIPPI

FACILITY NAME: UNITED TECHNOLOGIES ELECTRO SYSTEMS, INC (SUBSIDIARY)

ADDRESS: P.O. BOX 2228

COLUMBUS, MS 39701

U.S. EPA I.D.: MSD004010724

FACILITY TYPE: STORAGE

STATE AGENCY/
U.S. EPA REGION: DNR

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981		20,000	
1982	1.090	21,800	
1983	1.060	23,108	
1984	1.040	24,032	
1985		26,993	
1986	1.030	27,803	REVISION
1987	1.030	28,637	
1988		53,000	REVISION
1989	1.038	55,014	

TOTAL COST IN 1989 FOR MISSISSIPPI

\$ 55,014

STATE: NEW YORK

FACILITY NAME: CARRIER CORPORATION (SUBSIDIARY)

ADDRESS: CARRIER PARKWAY

SYRACUSE, NY 13221

U.S. EPA I.D.: NYD001317072

FACILITY TYPE: STORAGE

STATE AGENCY/
U.S. EPA REGION: NYSDEC

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	0	
1982	1.090	0	
1983	1.060	0	
1984	1.040	0	
1985	1.040	45,000	
1986	1.030	46,350	
1987		47,740	
1988	1.037	49,506	REVISION
1989	1.038	51,387	

DATE: 03/20/90 * * * CLOSURE COSTS (CONT.) * * *
PAGE: 11 EXHIBIT A

TOTAL COST IN 1989 FOR NEW YORK \$ 51,387

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TOTAL CLOSURE COSTS	\$ 6,288,729
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(RCRA PARTS 264 AND 265 SUBPART H)

STATE: CALIFORNIA

STATE: CONNECTICUT

<u>YEAR</u>	<u>INFLATION FACTOR</u>	<u>COST</u>	
1981	1.000	0	
1982	1.090	0	
1983	1.060	0	
1984	1.040	0	
1985		567,000	REVISION

DATE: 03/20/90 * * * POST CLOSURE COSTS (CONT.) * * *
PAGE: 13 EXHIBIT A

1986	1.030	584,010	
1987	1.030	601,530	
1988		562,309	REVISION
1989		3,534,118	REVISION

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: AIRCRAFT ROAD

MIDDLETOWN, CT 06457

U.S. EPA I.D.: CTD003935905

FACILITY TYPE: TREATMENT & DISPOSAL (INCL. SURFACE IMPOUNDMENTS & LANDFILL)

STATE AGENCY/

U.S. EPA REGION: DEP

YEAR	INFLATION FACTOR	COST	
1981		860,400	REVISION
1982	1.090	973,836	
1983	1.060	994,106	
1984	1.040	1,033,870	
1985	1.040	1,075,225	
1986	1.030	1,107,482	
1987	1.030	1,140,706	
1988	1.037	1,182,912	
1989	1.038	1,227,863	

FACILITY NAME: PRATT & WHITNEY AIRCRAFT GROUP (DIVISION)

ADDRESS: NEWELL STREET (O.R.C.)

SOUTHINGTON, CT 06489

U.S. EPA I.D.: CTD000844332

FACILITY TYPE: TREATMENT (INCLUDES SURFACE IMPOUNDMENTS)

STATE AGENCY/

U.S. EPA REGION: DEP

YEAR	INFLATION FACTOR	COST
1981	1.000	0
1982	1.090	0
1983	1.060	0
1984	1.040	0
1985	1.040	0
1986	1.030	0
1987	1.030	13,000
1988	1.037	13,481
1989	1.038	13,993

FACILITY NAME: SIKORSKY AIRCRAFT (DIVISION)

ADDRESS: 6900 MAIN STREET

STRATFORD, CT 06601-1381

U.S. EPA I.D.: CTD001449784

FACILITY TYPE: TREATMENT (INCLUDES SURFACE IMPOUNDMENTS)

DATE: 03/20/90 * * * POST CLOSURE COSTS (CONT.) * * *
 PAGE: 14 EXHIBIT A

STATE AGENCY/
 U.S. EPA REGION: DEP

YEAR	INFLATION FACTOR	COST	
1981	1.000	0	
1982	1.090	0	
1983	1.060	0	
1984	1.040	0	
1985		70,000	REVISION
1986	1.030	72,100	
1987		285,000	REVISION
1988	1.037	295,545	
1989	1.038	306,776	

TOTAL COST IN 1989 FOR CONNECTICUT

\$ 5,082,750

 STATE: FLORIDA

FACILITY NAME: PRATT & WHITNEY AIRCRAFT (DIVISION)

ADDRESS: P.O. BOX 2691

WEST PALM BEACH, FL 33402

U.S. EPA I.D.: FLD001447952

FACILITY TYPE: TREATMENT (INCLUDES TREATMENT TANKS WITHOUT CONTAINMENT)

STATE AGENCY/
 U.S. EPA REGION: DER

YEAR	INFLATION FACTOR	COST	
1981	1.000	0	
1982	1.090	0	
1983	1.060	0	
1984	1.040	0	
1985	1.040	0	
1986		604,500	REVISION
1987	1.030	622,635	
1988	1.037	645,672	
1989	1.038	670,208	

TOTAL COST IN 1989 FOR FLORIDA

\$ 670,208

TOTAL POST CLOSURE COSTS \$ 6,282,338

TOTAL CLOSURE AND POST CLOSURE COSTS \$ 12,571,067

Price Waterhouse



March 28, 1990

To the Board of Directors of
United Technologies Corporation

We have audited the consolidated financial statements of United Technologies Corporation and subsidiaries (the "Corporation") as of December 31, 1989 and for the year then ended and have issued our report thereon dated January 18, 1990. We have not audited any financial statements of the Corporation as of any date or for any period subsequent to December 31, 1989.

Reference is made to the letter dated March 27, 1990 to the Connecticut Department of Environmental Protection from Mr. John A. Rolls, Executive Vice President and Chief Financial Officer of United Technologies Corporation (the "Letter"). We have compared the amounts listed below and included in the Letter to the corresponding amounts included in the aforementioned consolidated financial statements, rounded to the nearest one hundred thousand, and found such amounts to be in agreement.

<u>Description</u>	<u>Amount (000's)</u>
Tangible net worth at December 31, 1989	\$ 3,382,600 (1)
Total assets in U.S. at December 31, 1989	\$ 9,255,700 (2)
(1) Shareowners' Equity, \$4,740,300; less Deferred Charges, \$1,357,700.	
(2) United States operations, \$9,255,700 only; excludes General corporate assets and other, \$1,441,500.	

Because the foregoing procedure does not constitute an audit made in accordance with generally accepted auditing standards, we do not express an opinion on the amounts listed above. In connection with this procedure, no matters came to our attention that caused us to believe that the amounts should be adjusted.

March 28, 1990
To the Board of Directors of
United Technologies Corporation
Page 2

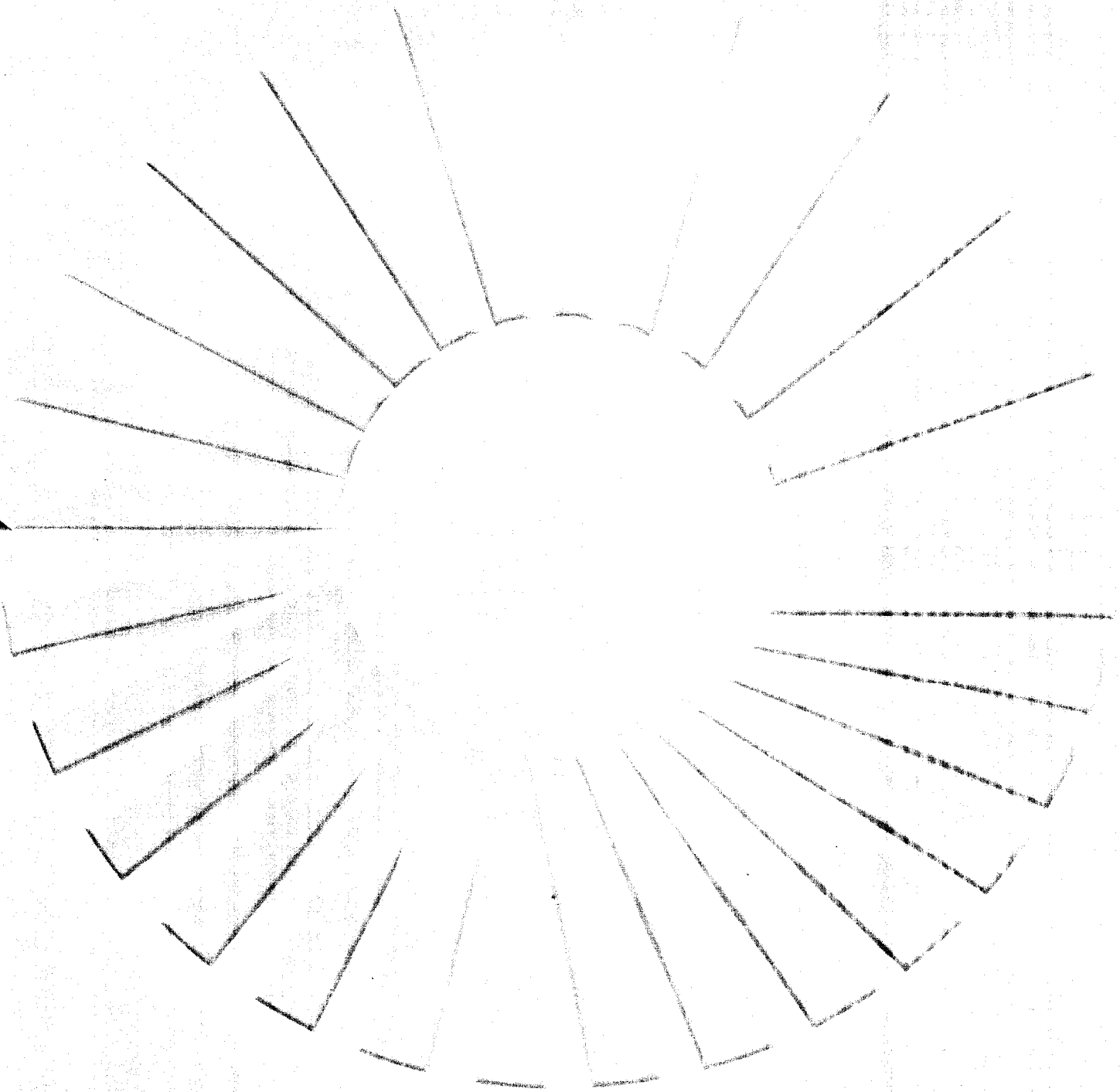


We performed no audit or other procedures with respect to the amount shown in the Letter for current closure and post-closure cost estimates. Accordingly, we do not express an opinion or any other form of assurance on such amount.

It is understood that this report is solely for your information and assistance in complying with the requirements of the Environmental Protection Agency - Subpart H of 40 CFR, Parts 264 and 265 and the regulations of authorized states, and should not be used for any other purpose.

Yours very truly,

Paul W. H. H. H.



Financial Summary

Millions of Dollars (except per share amounts)

United Technologies provides a broad range of high-technology products and support services to customers in the aerospace, building and automotive industries worldwide. Approximately half of UTC's sales come from businesses serving commercial and industrial markets. The remainder is split about evenly between commercial aerospace and defense-related operations.

UTC's Performance in Brief	1989	1988
Sales	\$19,532.1	\$18,000.1
Net Income	\$ 702.1	\$ 659.1
Earnings per share:		
Primary	\$ 5.34	\$ 5.05
Fully diluted	\$ 5.20	\$ 5.05
Dividends per common share	\$ 1.60	\$ 1.55
Yearend business backlog	\$20,125.0	\$16,875.0
Research and development	\$ 956.6	\$ 932.4
Capital expenditures	\$ 1,023.3	\$ 875.3

Significant Balance Sheet Items	December 31,	
	1989	1988
Assets		
Current assets	\$ 8,506.8	\$ 7,988.6
Fixed assets—net	\$ 3,951.9	\$ 3,406.6
Other	\$ 2,139.5	\$ 1,353.1
Liabilities		
Current liabilities	\$ 6,376.1	\$ 4,948.1
Long-term debt	\$ 1,959.6	\$ 1,642.8
Other	\$ 1,522.2	\$ 1,334.0
Shareowners' equity	\$ 4,740.3	\$ 4,823.4

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Dear Shareowner

I am pleased to report that United Technologies achieved record revenues and earnings in 1989. Revenues increased 6.7 percent to \$19.8 billion, while net income rose 6.5 percent to \$702.1 million. Per-share earnings were \$5.20 on a fully diluted basis, compared with \$5.05 in 1988.

The quality of our earnings reflects the disciplined approach we have taken to lowering the cost structure and improving the operating performance of our aerospace, building systems and automotive businesses. As we look out over the next several years, we see additional opportunities to reduce costs and maximize our resources. These continuing initiatives to enhance UTC's profitability are an essential part of our overall efforts to offer shareowners a superior return on their investment.

As an expression of confidence in UTC's continued earnings growth and working capital improvement, the board of directors last month increased the quarterly dividend 12.5 percent from 40 cents to 45 cents a common share. The board also declared regular quarterly dividends of \$1.125 on the \$4.50

preferred stock and \$1.20 a share on the convertible preferred stock held by the Employee Stock Ownership Plan, which we established in 1989 to improve our existing employee savings plan.

We remain committed to maintaining consistent performance improvement, while we explore new opportunities for future growth.

International revenues grew 18 percent in 1989 to \$9.8 billion, representing 50 percent of our total revenues, as we continue to expand our aggressive international marketing efforts. Continuing economic growth in the Pacific Rim and the impending integration of Western European markets offer us new opportunities in regions where we already are quite successful. And now, the political and economic progress being made by the nations of Eastern Europe offers us potential opportunities that would have been difficult to envision even a year ago.

Our investments will continue in core technologies and promising joint ventures that are closely tied to our existing operations. With our marketing, manufacturing and management skills in place worldwide to meet the changing needs of our customers, we have a broad, solid foundation from which to continue to build a truly global business. This international business base is particularly advantageous during the economic sluggishness now beginning to occur in certain North American markets.

One area that will experience a slowdown over time is the defense business. In recent years, UTC has been very successful in reducing its reliance on defense contracts. Military and space-related work, in fact, represented less than 25 percent of our total revenues in 1989. UTC will, of course, continue its long and proud role as a government contractor. However, we have developed a much more stringent assessment of the risk factors involved in defense-related projects, especially as it relates to fixed-price development contracts. We are sensitive to the importance of earning an adequate return on defense

business in general. As a result, we expect to be able to improve our profitability, despite overall reductions in government business.

UTC's board of directors has elected two new members who bring broad experience and distinguished careers to the task. Gerald D. Hines, one of the largest real estate developers in the United States, has been active in real estate and development for more than 30 years. Former U.S. Senator Howard H. Baker, Jr., who after 19 years in the Senate and service as President Reagan's chief of staff, has earned widespread bipartisan respect for his wisdom and integrity.

Edward W. Large, an executive vice president who served UTC for some 35 years, will retire from the board and the corporation at the end of April 1990. Ed was an architect of much of UTC's expansion in the 1970s, and he has contributed substantially to the success of the corporation's business development efforts. We will miss his sage advice and counsel.

Every employee, at every level in every function, makes a special contribution to the success of a great corporation. I thank all our employees for the successes UTC achieved in 1989. As we move into the 1990s, we remain committed to maintaining consistent performance improvement, while we explore new opportunities for future growth.

Sincerely,

Robert F. Daniell

Robert F. Daniell
Chairman and Chief Executive Officer

February 1, 1990

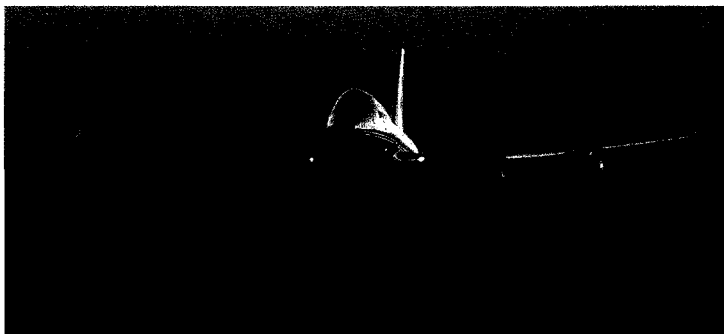


UTC at a Glance

(1989 Revenues)

Aerospace and Defense

Power



**Pratt & Whitney
Commercial Engine Business**
\$3.4 billion

**Pratt & Whitney
Government Engine Business**
\$2.5 billion

Pratt & Whitney Canada
\$1.0 billion

Primary Customers

Commercial airlines and aircraft leasing companies; U.S. government, including NASA and the military services; non-U.S. governments; regional and commuter airlines; aircraft manufacturers; private business.

Principal Products and Services

Commercial and military jet engines, spare parts and product support, including engineering and development, specialized engine maintenance, overhaul and repair services; rocket engines and space propulsion systems; small gas turbine engines, spare parts and related services for business and regional/commuter aircraft, and for fixed-wing military aircraft and helicopters.

35%

Flight Systems



Sikorsky
\$1.8 billion

Hamilton Standard
\$1.0 billion

Missiles and Space Systems
\$652.9 million

Norden
\$132.9 million*

Primary Customers

U.S. government, including NASA and the military services; non-U.S. governments; aerospace and defense prime contractors; airframe and jet-engine manufacturers; oil industry and other corporate businesses; hospitals and ambulance services.

Principal Products and Services

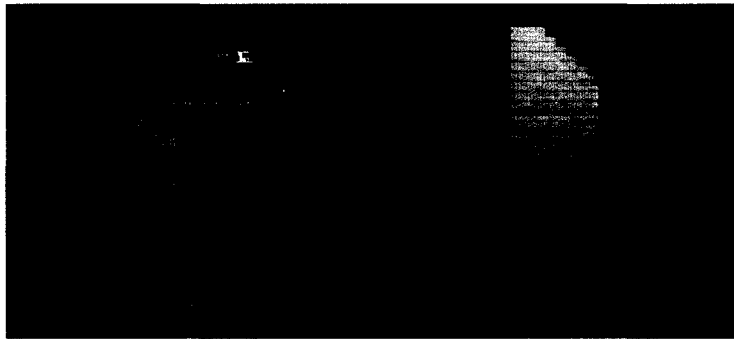
Military and commercial helicopters and related maintenance services; jet-engine and flight controls; aircraft propellers; environmental controls for aircraft, spacecraft and submarines; space life-support systems; space launch systems; processing and refurbishing nonmotor segments of space shuttle boosters; solid rocket motors for strategic and tactical weapons systems; high-technology robotics; military radar systems and computers; battlefield command and control systems; air traffic control radar systems; high-technology optical systems.

18%

*Total revenues were \$322.5 million.

Commercial and Industrial

Building Systems

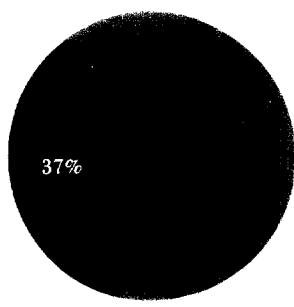


Carrier
\$4.0 billion

Otis
\$3.3 billion

Primary Customers
Mechanical and building contractors; homeowners, building owners and developers; architects and consultants; transportation companies and shipping operations.

Principal Products and Services
Heating, ventilating and air conditioning (HVAC) equipment for commercial, industrial and residential buildings; industrial and transportation refrigeration units; HVAC replacement parts and services; building controls; elevators, escalators, moving walks and shuttle systems, and related installation, maintenance and repair services; modernization products and services for elevators and escalators.



Industrial Systems

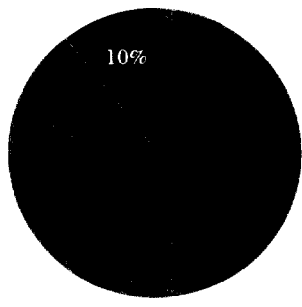


UT Automotive
\$1.7 billion

Control Systems
\$273.3 million

Primary Customers
Original equipment manufacturers of automobiles, trucks, and off-road vehicles and equipment; automotive aftermarket suppliers and service centers; HVAC and appliance manufacturers.

Principal Products and Services
Automotive wire harness systems; DC electric motors and actuators; electromechanical and electronic switches, modules, control systems and components; automotive interior trim systems and components; hydraulic systems and components; automotive emissions test equipment and inspection services.



Aerospace and Defense

Pratt & Whitney (P&W) had its strongest year ever in 1989. Commercial engine orders, including options, totaled nearly \$12 billion—more than double the \$5 billion in orders and options announced in 1988. At yearend, P&W's backlog of commercial orders, including options, amounted to \$19.9 billion, a 75 percent increase over the 1988 total. Pratt & Whitney Canada also had a very strong year, as the company continued to enhance its position in the growing market for general aviation and regional airline engines.

On the military side, Pratt & Whitney won the majority share of the U.S. Air Force's fighter engine competition for the third consecutive year in 1989. Pratt & Whitney also completed all ground demonstrator program requirements for the F119 engine, P&W's powerplant for the U.S. Air Force's new Advanced Tactical Fighter.

Commercial Engine Business Has Record Year

Pratt & Whitney's record volume of commercial business in 1989 reflects strong market demand for new aircraft and the engines to power them. The PW4000, P&W's most powerful engine, accounted for approximately \$4.7 billion in orders and options for the year. Commercial airlines and aircraft leasing companies worldwide ordered some 479 PW4000s, with options on more than 200 additional engines, to power their new wide-body aircraft.

The PW4000 is now installed on every type of wide-body currently in production and those slated for certification. As more powerful engines are needed for even larger aircraft such as the proposed Boeing 777, the PW4000 is well-positioned for success because of its built-in potential to "grow" in thrust capacity. The first growth version of the PW4000 family of engines was selected in 1989 by Northwest Airlines to power its new Airbus A330 twinjet.

In the intermediate-thrust range, the PW2000 engine captured 75 percent of the 1989 engine orders for the mid-size Boeing 757 twinjet. Northwest Airlines awarded Pratt & Whitney a \$1.5 billion order, including options, for PW2000 and PW4000 engines to power as many as 90 Boeing aircraft. United Airlines selected the PW2000 for its new 757 fleet—an engine order with a potential value of more than \$1.4 billion, if all options are exercised.



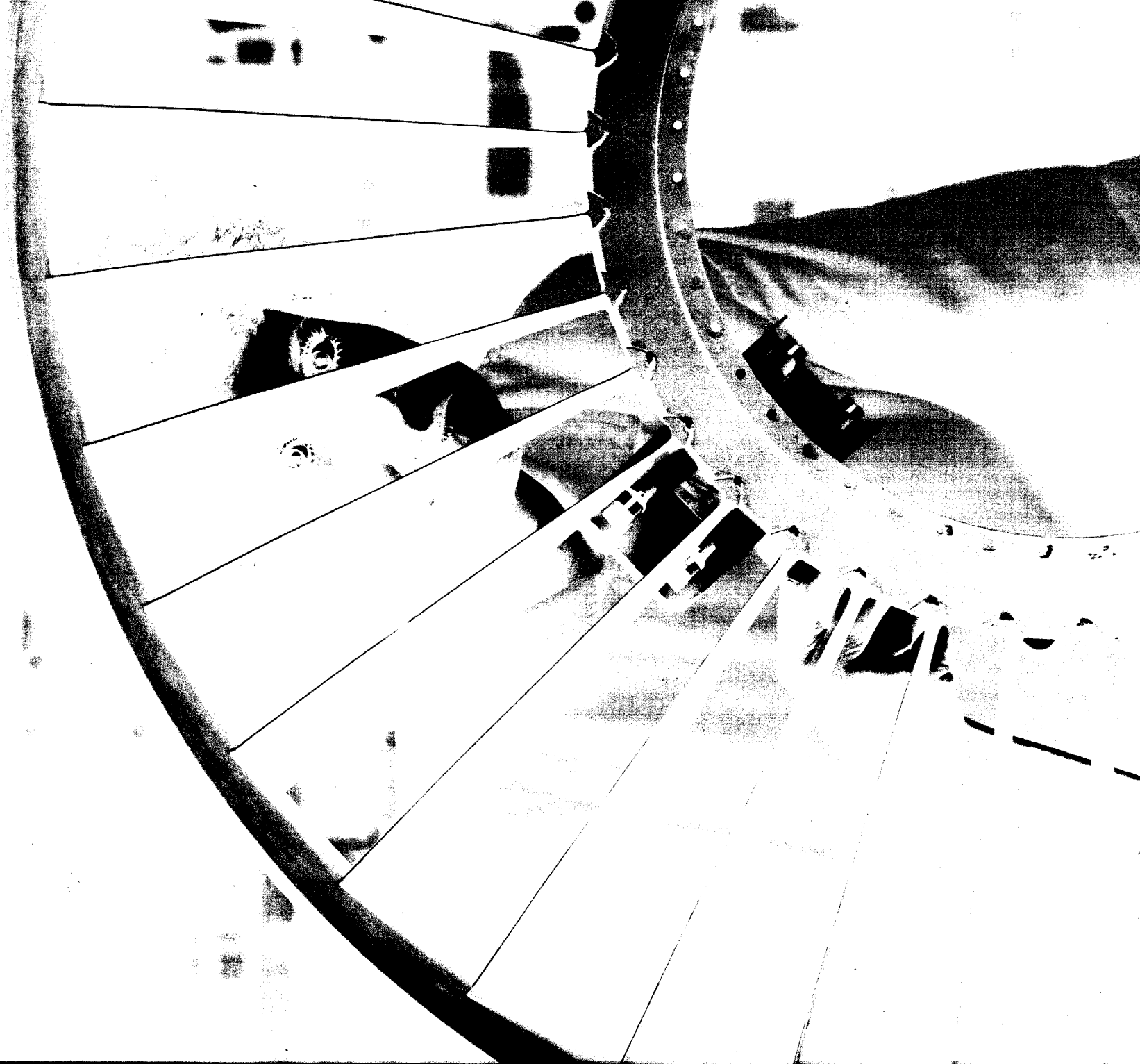


***Pratt & Whitney's new-technology engines
are helping airlines modernize and expand
their fleets to meet traffic growth. . . .***

Having anticipated the product and market requirements of its commercial customers, Pratt & Whitney has positioned itself as the only manufacturer in the industry able to offer new-technology engines for both wide-body and standard-body aircraft. These highly ad-

vanced power plants are helping airline operators update their fleets with planes that can carry more passengers, farther, with greater economy. For example, P&W's largest and most powerful turbofan, the PW4000, is the most fuel-efficient high-thrust engine ever built. It also offers the lowest maintenance costs

of any engine in its class, and is able to "grow" to meet future thrust requirements. As a result, the PW4000, which accounted for \$4.7 billion in orders and options in 1989, has become the engine of choice to power today's wide-body aircraft.



Pratt & Whitney's support services are responding to a customer need to boost fleet operating efficiencies. . . .



With the demand for new commercial aircraft continuing to surge and with carriers striving to keep their fleets running efficiently, overhaul and repair capacity is at a premium. Pratt & Whitney is positioning itself to meet this customer need by expanding its engine overhaul and repair capabilities in the United States and Singapore, by revamping its new facility in the Netherlands and by opening a product support operation in Ireland. Pratt & Whitney also has tailored comprehensive programs to improve parts deliveries and increase spare engine availability. And its field support staff has been nearly doubled to respond to customer needs quickly, on the spot.



The V2500, an engine developed by the five-nation International Aero Engines consortium in which P&W is one of the principal shareowners, entered commercial service in mid-1989 on the Airbus A320 twinjet. Later in the year, McDonnell Douglas selected the V2500 as its engine to power the new MD-90 aircraft. Delta Air Lines became the launch customer of the V2500-powered MD-90 with an order, including options, for as many as 160 aircraft in 1989. The engine order has a potential value of nearly \$2 billion.

Demand for P&W's workhorse engine, the JT8D, remained strong. Customers ordered more than 1,300 JT8D-200 turbofans, including options, valued at \$3.5 billion, to power McDonnell Douglas MD-80 aircraft. The 13,000 JT8Ds and 3,600 other engines now in service, combined with the growing number of P&W engines entering service, should provide a viable spare parts and aftermarket service business throughout the 1990s. Pratt & Whitney also is producing "hush kits" that will help extend the useful life of aircraft powered by standard JT8Ds by bringing them into compliance with today's stricter noise standards.

Pratt & Whitney Wins Fighter Engine Business

Pratt & Whitney won a 60 percent share of the U.S. Air Force's fighter engine requirements in 1989. In addition to the F100-PW-220 engine, the order included P&W's more powerful F100-PW-229 for the first time. This improved-performance engine gives Pratt & Whitney thrust parity with the competition and enhances its competitive position in international markets. In the 1990 round of the U.S. Air Force's annual fighter engine competition, the new F100-PW-229 accounted for half of the total order.

Pratt & Whitney is developing the F119 engine to compete for the U.S. Air Force's Advanced Tactical Fighter business in the 1990s and beyond. The company will deliver six F119s to the two competing aircraft teams in early 1990 for flight-testing in prototype aircraft. A final aircraft-engine team is expected to be selected by the Air Force in 1991.

In space propulsion, P&W's RL10 rocket engine has completed 286 successful consecutive firings within the last three decades. More than 120 RL10 engines were on order at yearend, with production expected through at least 1996. Pratt & Whitney currently is testing the RL10A-4 model, which has 25 percent higher thrust, for the Atlas IIA vehicle.

Also, NASA selected Pratt & Whitney for the Advanced Expander Test Bed Rocket Engine Program, a five-year program to develop technology for advanced rocket engines in the 7,500-to-50,000-pound-thrust category.

Component testing began in 1989 on the alternative high-pressure turbopump that Pratt & Whitney is developing for the Space Shuttle Program. This effort to improve the reliability of the shuttle's main engines began in 1986 and will continue through 1993. Pratt & Whitney also is working on a hypersonic propulsion system for the proposed National Aerospace Plane. The company has successfully completed full-scale testing at Mach 6, with the ultimate goal of producing an engine capable of attaining speeds up to Mach 25.

Pratt & Whitney Canada Raises Market Position

Pratt & Whitney Canada (PWC) had a very successful year, increasing its share of small gas-turbine engine sales from 25 percent in 1988 to 27 percent in 1989.

In one major competition, GPA Group Ltd. ordered 88 ATR42, ATR72 and de Havilland Dash 8-300 commuter aircraft, all powered by the PW100 family of turboprop engines. The company continues to expand its PW100 series, with growth variants of its most powerful production model, the PW125B, currently under development. PWC also continues to develop the PT6 turboprop for additional applications. In 1989, this engine was chosen to power two new aircraft, the Beech Super King Air 350 and the Pilatus PC-12.

The PW300 turboprop, PWC's newest offering for business jet customers, was selected by British Aerospace to launch the BAe 1000 aircraft. The PW300 is a 5,000-pound-thrust-class engine for mid-size business jets with transcontinental range.

The new 901A auxiliary power unit, which provides aircraft with power for starting, lights and air conditioning, entered service in 1989 with the Boeing 747-400. The PW206A, PWC's new turboshaft engine, was selected by McDonnell Douglas for its MDX light helicopter.

Sikorsky Adds to International Business

Sikorsky has been successful in supplementing its core helicopter production programs for the U.S. military services with important new business in international markets. International sales accounted for nearly one-fourth of Sikorsky's total revenues in 1989, up from some six percent five years ago. There has also been renewed interest in the versatility of helicopters, such as Sikorsky's commercial S-76 aircraft, for non-military uses.



Pratt & Whitney has been saluted by the U.S. Air Force for quality manufacturing and for cost-cutting achievements. . . .



Pratt & Whitney won two important U.S. Air Force awards in 1989 that reflect the company's firm commitment to providing customers with quality products at the lowest cost. Pratt & Whitney was the only company this year to receive the Big Q Award for producing high-quality aircraft engines and parts—the second year in a row it has received this coveted award. Pratt & Whitney earned the Cost Cutter Award for exceptional performance in cutting contract costs. Pratt & Whitney also won the majority share of the Air Force's fighter engine requirements for the third consecutive year in 1989.



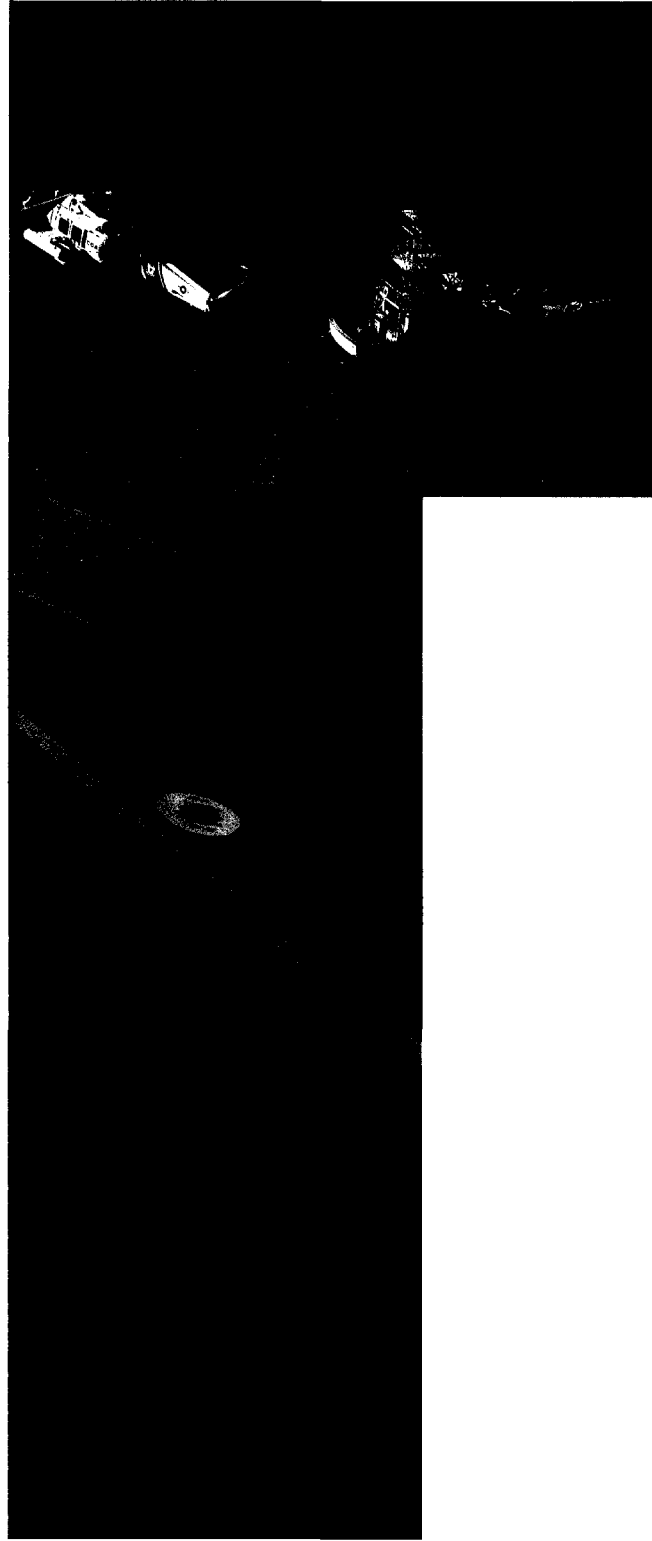


Sikorsky developed its newest search-and-rescue helicopter to meet the Coast Guard's special mission requirements. . . .

S

Sikorsky is under contract to supply the U.S. Coast Guard with 24 HH-60J JAYHAWK helicopters, replacing a fleet of Sikorsky-built aircraft that have been in service for more than 20 years. The JAYHAWK, with its advanced avionics and communications equipment, will play a vital role in the Coast Guard's search-and-rescue and drug interdiction missions. The new helicopter is a derivative of Sikorsky's core naval model, the SEA-HAWK. Derivatives are strategically important to Sikorsky, because they help to maximize the return on its original R&D investments and because much of the company's future growth is expected to come from sales of derivative aircraft to international markets.





Sikorsky has been aggressively pursuing new business in international markets. For example, Sikorsky has major marketing initiatives under way in Japan, Turkey and the Republic of Korea, and in 1989, the Hong Kong government awarded Sikorsky a \$54 million contract for eight S-76 helicopters, with options for another four aircraft potentially worth \$30 million. More than half of the company's S-76 deliveries during the year were to overseas customers.

Current U.S. government requirements continue to drive production of Sikorsky's core product line, the U.S. Army UH-60A BLACK HAWK and the Navy SH-60B SEAHAWK, as well as derivative aircraft for military customers in both the United States and overseas. BLACK HAWK and SEAHAWK aircraft are also being manufactured under license in Australia and Japan. In addition, Sikorsky has been developing a prototype for the U.S. Army's MH-60K special operations aircraft, a BLACK HAWK derivative that incorporates sophisticated avionics and other equipment to meet U.S. readiness needs for unconventional combat missions.

The company has begun full-lot production of 175 SH-60F CV Helo derivatives of the basic SEAHAWK model, which will be used by the U.S. Navy for antisubmarine warfare. Meanwhile, Sikorsky continues to produce the heavy-lift CH-53E SUPER STALLION for the U.S. Marine Corps and the MH-53E SEA DRAGON for the U.S. Navy. Three of 12 SEA DRAGON helicopters were delivered to Japan in 1989 for service with the Japanese Defense Agency.

Sikorsky is teamed with Boeing Helicopter Company to compete for production of the LHX aircraft, the next generation of U.S. Army helicopters. The winning team is expected to be named in late 1990.

United Technologies and Dow Chemical Company formed a joint-venture company in 1989 that will provide advanced composite components for the aerospace, defense and automotive industries worldwide. The new venture will combine Dow's advanced composites fabrication-related technology with Sikorsky's expertise in developing and manufacturing composite parts for the aerospace industry.

Hamilton Standard Posts Record Backlog

At Hamilton Standard, new commercial and military business resulted in a record yearend backlog that was balanced along all product lines. Several contracts were awarded to produce propellers, environmental control systems and engine controls for new regional commuter aircraft. Hamilton Standard also won a major contract to supply environmental control equipment for Boeing airliners through the mid-1990s.

Nord-Micro, a West German affiliate, received a contract to supply the cabin-pressure control system for the U.S. Navy's new P-7A antisubmarine warfare aircraft. Nord-Micro and Microtecnica, an Italian affiliate, expanded their participation in European space programs, and Hamilton Standard won new contracts for work on the U.S. space station and Japan's space station module.

Hamilton Standard opened a customer service center in 1989 that is devoted to aircraft equipment overhaul and repair services. The new facility's streamlined workflow system has accelerated turnaround time to airline and military customers and has improved the division's overall business results.

United Technologies Optical Systems (UTOS) has been integrated into Hamilton Standard's operations—a strategic move that provides a natural synergy between UTOS' pioneering optical and electro-optical technology and Hamilton Standard's flight systems, avionics and space capabilities. Also, Hamilton Standard purchased fiber-optic patent and technology rights from Thompson CSF of France, which enhances the division's guidance and rotary-wing flight control technology.

Other Flight Systems Units Strengthen Prospects

The Chemical Systems Division (CSD), which manufactures solid rocket motors for strategic, tactical and space launch vehicles, achieved a series of technical successes during the year that strengthened its prospects for future programs. For example, the first Titan IV, the U.S. Air Force's newest expendable launch vehicle which CSD has been helping to develop, was launched successfully in 1989, as was the first Commercial Titan Launch Vehicle. Martin Marietta Corporation has ordered seven additional Titan IV booster assemblies. In addition, CSD's third-stage motor powered a series of successful Trident D-5 missile test launches.

USBI, which assembles and refurbishes solid rocket motors for the U.S. Space Shuttle Program, contributed to three shuttle launches in 1989. Meanwhile, Space Flight Systems continued work on a NASA study contract for an unmanned version of the space shuttle, and was asked to submit a proposal to design and build a commercial spaceport in Australia.

Norden's major radar programs, the Joint STARS (Surveillance Target Attack Radar System) and the Multi-Mode Radar System, both recorded numerous successful flight tests in 1989 as they move toward production. In addition, the initial set of Airport Surface Detection Equipment was delivered in January 1990 to the Greater Pittsburgh International Airport, the first of some 30 U.S. airports that will receive this system.

Hamilton Standard technology provides fuel-efficient power and passenger comfort aboard the Boeing 747-400. . . .



Boeing's newest wide-body jet comprises state-of-the-art technology that includes 25 Hamilton Standard components. A Hamilton Standard environmental control system, for example, cools and heats the aircraft and provides cabin pressurization. This system draws power from Pratt & Whitney Canada's advanced, energy-saving auxiliary power unit, which is managed by Hamilton Standard fuel and pneumatic system controls. And the "brain" behind Pratt & Whitney's high-thrust PW4000 turbofan, which powers the aircraft, is a full-authority digital electronic control system from Hamilton Standard that automatically and efficiently regulates the engine's fuel controls and gas turbine accessories.





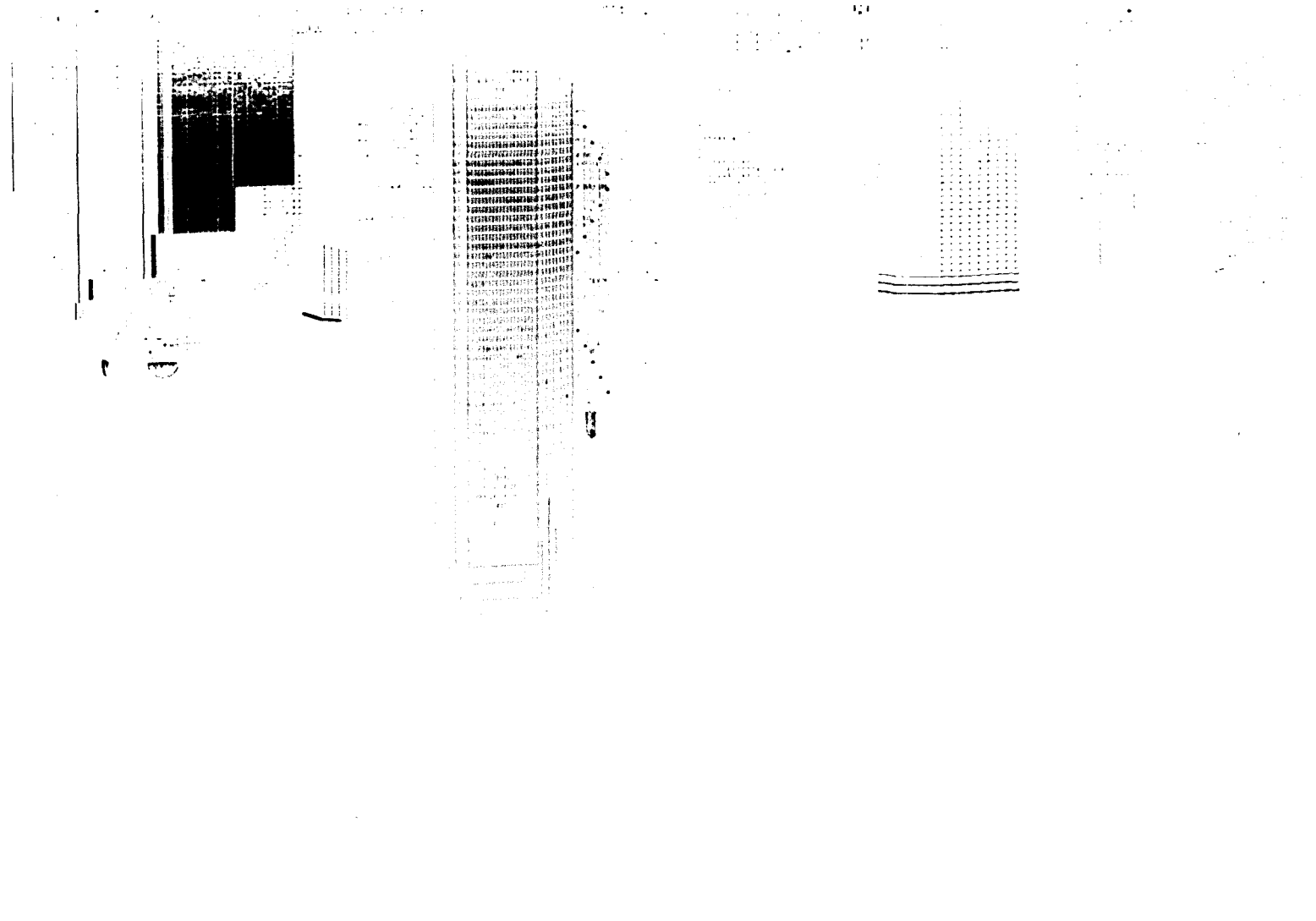
Advances in engineering and electronics make Otis and Carrier building systems more efficient, reliable and easier to install. . . .

6

Carrier and Otis, driven by a common commitment to customer satisfaction and engineering excellence, are incorporating microprocessor technology and other innovations throughout their product lines. Carrier, for example, is featuring factory-installed electronic controls that reduce the total installed cost of its

commercial heating and cooling equipment. For large, complex building installations, an advanced remote control system—the Carrier Comfort Network—can detect and report equipment malfunctions, even before they are recognized by building maintenance personnel. Microprocessor-based sys-

tems give Otis elevators the ability to "think" for themselves, as well. The control system engineered into the new Eleconic® 411 elevator, Otis' most advanced high-rise application, continuously anticipates a building's traffic demands and positions elevators to provide the most responsive service.





Commercial and Industrial

Otis, the world's leader in manufacturing, installing and servicing elevators and escalators, had a very strong year in 1989, mainly due to good international market conditions and to its large, growing aftermarket business. Service and modernization activities accounted for more than half of the company's total revenues and a sizable portion of its profits in 1989. In addition, Otis has been winning increasingly larger shares of the U.S. and world markets for new equipment.

Otis Enhances Its Leadership Position

At yearend, Otis' share of the global new-equipment market was 24 percent, twice that of its nearest competitor. Otis is the only elevator manufacturer with double-digit market shares in all major elevator markets worldwide. In Japan, where the demand for technologically advanced products is greater than in other areas, Otis has more than doubled its new-equipment market share to 14 percent during the past five years.

The company has been actively pursuing business in Eastern Europe and the Soviet Union and continues to increase its investment in a joint venture in the People's Republic of China. And with its longstanding organization in Western Europe, Otis is well-positioned to address the market changes that are expected after 1992, when trade barriers within the European Economic Community are lowered.

Otis also has been incorporating advanced technologies and customer-service innovations throughout its entire product line to enhance its leadership position. In 1989, as part of a five-year, \$400 million engineering program begun in 1986, the company completed a new engineering center in Tokyo, its sixth such facility in the world. Otis also plans to open additional manufacturing facilities in Brazil, India and Japan in 1990.

Otis has introduced several new products targeted at growing segments of the construction industry. For example, the company launched the Elevonic® 411 system, its most advanced high-rise elevator, in 1989. Otis' new interactive Elevator Management System (EMS), when linked to Elevonic 411 or other systems, allows building managers to monitor and adjust the performance of up to 64 elevators from a central location.

Otis also introduced the mid-rise SPEC90™ elevator in 1989. Manufactured in Japan for sale throughout the Pacific region, the new SPEC90 system is well suited to the six- and seven-story projects being constructed in rapidly developing countries such as India, Thailand, Korea and Indonesia. The SPEC90 system builds on the worldwide success of its predecessor, the SPEC60™ elevator. Its quieter operation, enhanced performance time, smaller machinery and fiber-optic communication links are engineering improvements over comparable products on the market.

Nippon Otis, the company's Japanese joint venture, unveiled the industry's first linear induction motor (LIM) elevator system in 1989. With its motor mounted in the counterweight, the LIM system allows for a space-efficient mid-rise elevator that eliminates the need for a machine room. The highly advanced system is especially important to the elevator market in Japan, where building space is at a premium. It will be released for sale there in 1990.

Also in 1990, Nippon Otis will begin installing the \$15 million "people mover" shuttle system connecting a new terminal and gate area at Tokyo's Narita International Airport. Another shuttle system has been ordered by the J. Paul Getty Centre in Los Angeles, California.

New Carrier Products Aimed at Higher Profits

Carrier, the world's leading producer of heating, ventilating and air conditioning equipment, introduced 28 new product lines in 1989 for residential and commercial applications. In the past three years, the company has released a total of 93 new product lines, which accounted for some 70 percent of its North American sales in 1989.

These customer-oriented products are the result of substantial capital and R&D expenditures and reflect the company's drive toward higher quality and technological differentiation. They are expected to help Carrier enhance its future profitability. They are also aimed at helping the company capture larger portions of the growing add-on and replacement business in North America, as well as expanding international markets. To maintain its leadership position, Carrier continues to invest in new technologies related to advanced compressors, electronics and alternate refrigerants.

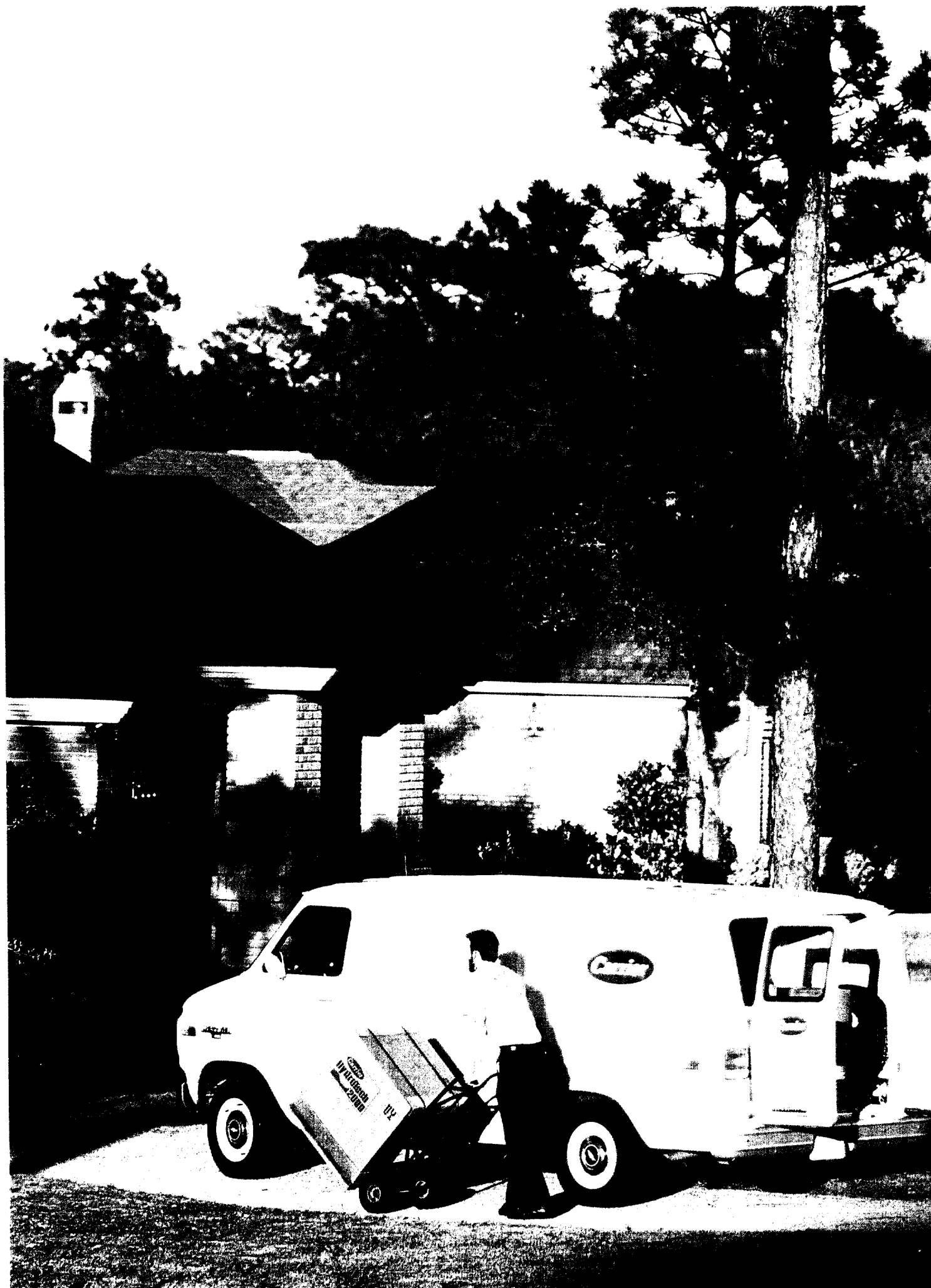


Otis constantly monitors its equipment and can dispatch a service crew within minutes of a customer's call. . . .



There are more than 1,700 Otis field offices with some 20,000 service technicians maintaining 634,000 elevators and escalators worldwide. When an Otis elevator shuts down anywhere in the United States or Canada, customer service representatives at the OTISLINE® centralized dispatching center are on hand day or night, to send a mechanic to the site immediately. Otis France operates a similar dispatch network in Paris. Another Otis innovation, remote elevator monitoring (REM), is an electronic monitoring and diagnostic device located inside the elevator that identifies problems and dispatches mechanics, often before building owners are aware of the situation. The system also is used to analyze and resolve the causes of equipment malfunctions to help technicians identify areas for preventive maintenance.







Carrier's all-new product lines offer homeowners higher quality and reliability, improved comfort and quieter operation. . .



Carrier is marketing completely redesigned central air conditioners and electronically controlled gas furnaces for the residential market. The new HydroTech2000™ heat pump, for example, combines space heating and cooling with domestic water heating to save homeowners up to 45 percent in energy costs over comparable systems. The innovations developed for the HydroTech2000 unit will benefit the entire line of Carrier Tech2000™, Bryant and Day & Night Reliant™, and Payne Endura™ products. The Infinity™ gas furnace also uses the same variable-speed, microprocessor-controlled technology that contributes to the efficiency, comfort and quiet operation of the HydroTech2000 system.

Among the new products released in North America during the year were central air conditioning units and heat pumps for residential applications, and a small, quiet, efficient furnace for homes. Carrier also introduced new rooftop cooling and heating units for commercial installations such as shopping centers and low-rise office buildings. These new products are designed for increased quality and reliability, as well as for easier installation and serviceability.

Another new-product innovation is the Carrier Refrigeration Management System, which was developed to safely recycle CFC-11, a refrigerant linked to ozone depletion. CFC-11 is used in approximately 80 percent of the world's centrifugal chillers. The new Carrier system will provide a cost-effective way of minimizing CFC-11 emissions into the environment during routine servicing and emergency repairs.

Carrier announced in 1989 that it will open a new facility in the United States to manufacture advanced-technology scroll compressors for use in residential and light commercial air conditioners and heat pumps. Scroll compressors are smaller, lighter, quieter and more efficient than compressors currently being used. Production will begin in 1991.

Carrier benefited throughout 1989 from strong performances by its European operations, particularly its distribution companies and two of its subsidiaries, Delchi in Italy and Interclisa in Spain. Carrier's ability to serve offshore markets with local operating companies has led to market share gains worldwide.

Carrier is represented in some 120 countries and is the leader in each of the two most rapidly expanding geographic markets for air conditioning: Carrier is the leading supplier in Europe and the Mediterranean region, which includes the Middle East; the company also is the market leader in the Far East, excluding Japan, where Carrier faces formidable competition from local companies. Toyo Carrier, a Japanese-based subsidiary, announced in 1989 that it will build an engineering center in Japan to strengthen product lines sold there and throughout the Asia-Pacific region.

Carrier Transicold Division, which sells to worldwide transport refrigeration and air conditioning customers, also contributed to Carrier's 1989 operating performance and achieved market share gains throughout the year. The division's container refrigeration unit sales increased 70 percent, fueled by orders from leasing companies such as Itel, TransAmerica and Triton, and from Maersk, one of the world's largest shipping companies. Transicold's truck and trailer refrigeration business posted a 20 percent increase in sales over its 1988 total.

UT Automotive is working closely with car makers to meet their needs for value-added product design and quality assurance. . . .



Prompted by quality and cost-improvement requirements, auto manufacturers throughout the world are asking their key suppliers to take on increased design and engineering responsibility for their products. UT Automotive is addressing this industry trend by forming closer

working relationships with its customers—from product development through production. For example, a company representative works full-time at the Ford assembly plant where the 1990 Lincoln Town Car is in production to ensure that the components and systems supplied by UT Automotive continue to satisfy the

customer's quality requirements. The Town Car contains UT Automotive products valued at more than \$1,000 per vehicle, including the instrument panel, steering wheel, wiring systems, switches, window-lift motors, keyless entry module, hydraulics and trim.



UT Automotive Achieves Record Revenues

UT Automotive (UTA) achieved record revenues for the seventh consecutive year in 1989, primarily due to increased market penetration in North America and strong car sales in Europe, which offset the effects of lower U.S. auto production.

The company has been increasingly successful in penetrating key automotive markets worldwide by meeting customer requirements for quality products and integrated systems. During the year, UTA completed design and development of modular headliners for General Motors, electrical distribution systems for certain Ford and Chrysler models, and door and sidewall trim for a 1991 GM model. UTA will supply multi-function switches for future models of several Ford vehicles, as well as for certain 1993 General Motors models. The company also won an order to supply keyless entry systems for various GM luxury models.

UTA's business with Japanese and Korean automakers operating in North America has been increasing. The company will be supplying NUMMI, the joint venture between General Motors and Toyota, with brake hose assemblies and fender liners and will supply Hyundai's Canadian operations with air-conditioning and power-steering hose assemblies. UTA also will design and produce four new electronic modules for Nissan's North American operations.

UT Automotive is positioning itself in Europe for the anticipated market changes resulting from economic unification after 1992. As part of its strategy, the company is focused on building its wire systems and engine cooling business to meet emerging customer needs. During 1989, key business awards were received from PSA and Fiat.

United Technologies acquired the remaining interest in Sheller-Globe Corporation, a leading supplier of steering wheels, instrument panels and other automotive components. Sheller-Globe's broad experience—combined with UTA's expertise in designing and manufacturing electrical distribution systems, switches, motors, electronics and trim systems—provides automakers with one of the most complete engineered systems capabilities in the industry.

To further strengthen its ties with customers, UT Automotive continues to enhance its reputation for quality products and improve the productivity of its operations worldwide. In 1989, UTA received numerous quality awards from Ford, Chrysler and General Motors, as well as from Ford of Europe.



Management's Discussion and Analysis of Results of Operations and Financial Position

The following discussion and analysis sets forth certain factors which produced changes in the Corporation's results of operations during the three-year period ended December 31, 1989, and comments on the Corporation's financial position at that date as presented in the accompanying financial statements. Operating results of the Corporation's business segments are shown in the Consolidated Summary of Business Segment Financial Data on pages 51 through 53 of this Annual Report.

In addition to the factors noted below, economic inflation tended to produce modest increases in material prices, employee compensation and other costs and in the Corporation's selling prices to customers.

Results of Operations

Revenues increased:

7% or \$1.2 billion from 1988 to 1989;

6% or \$1.1 billion from 1987 to 1988.

Sales increased 9% and 5% (10% in each year excluding the sales of the Corporation's Essex subsidiary which was sold in February 1988) in 1989 and 1988, respectively. It is estimated that increases in selling prices to customers averaged 4% in 1989 (3% in 1988). The net impact of translating sales of foreign subsidiaries was to reduce 1989 sales by 1% and increase 1988 sales by 1%, indicating that the real volume of sales increased approximately 6% and 1% (7% in 1989 and 6% in 1988 excluding the sales of Essex) in 1989 and 1988, respectively.

Revenues of the Corporation's principal business segments for the years ended December 31 were:

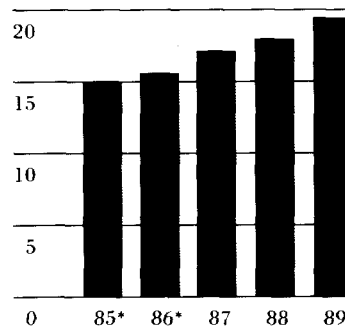
In Millions of Dollars	1989	1988	1987
Power	\$6,991.1	\$6,346.7	\$5,739.6
Flight Systems	\$3,592.1	\$3,505.8	\$3,246.0
Building Systems	\$7,260.7	\$6,523.3	\$5,734.3
Industrial Products for the Automotive and Other Industries	\$1,931.6	\$1,965.8	\$2,713.9

In 1989, 48% of Power segment sales were in the commercial airline market (48% in 1988 and 47% in 1987); 36% were for military use (37% in 1988 and 1987); 15% were in the general aviation market (14% in 1988 and 13% in 1987); and the remainder were in other markets.

Power revenues increased in 1989 by \$644.4 million, or 10%. All businesses within this segment contributed to the increased revenues. The increase in the commercial business was due in large part to increased shipments of the PW4000 engine and increased spare parts sales. As of December 31, 1989, 39 airlines have placed firm orders for a total of 1,090 PW4000 engines. Sales and orders for this engine have placed it on all wide-bodied aircraft currently produced or scheduled for production. The increases in the other businesses were a result of both increased engine and spare parts sales. Revenues increased in 1988 by \$607.1 million, or 11%, primarily as a result of increased sales of commercial engines. The increase in commercial engine sales was due in large part to increased sales of the PW4000 engine, which was phased in during 1987, and continued strong demand for the JT8D engine. The general aviation business also contributed increased engine sales in 1988. These increases were offset to some extent by lower spare parts sales in the government engine business.

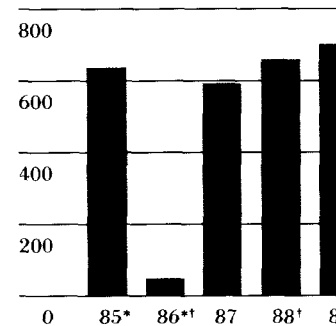
Helicopter business revenues in 1989 contributed 49% of Flight Systems segment revenues (49% in 1988 and 47% in 1987) and the remainder were from sales of defense electronics, space propulsion and other aircraft products. Revenues of this segment i

Sales
\$ Billions



* Continuing operations

Net Income
\$ Millions



* Continuing operations

† Includes the restructuring provisions discussed on page 33.

creased \$86.3 million, or 2%, in 1989. All segment businesses other than missiles and space contributed to the improvement. Revenues of this segment increased \$259.8 million, or 8%, in 1988. The increased revenues resulted from improvement in the helicopter business due to an increase in units sold, improved prices for certain products and increased royalty income, and from improved revenues at the Hamilton Standard Division offset to some extent by lower revenues at Norden Systems.

Building Systems segment 1989 revenues were derived 55% from air conditioning products and services (54% in 1988 and 56% in 1987) and 45% from elevator and escalator products and services (46% in 1988 and 44% in 1987). Revenues increased 11%, or \$737.4 million, in 1989 and 14%, or \$789 million, in 1988. The impact of foreign exchange rates versus the dollar reduced sales in 1989 by approximately \$131 million and increased sales by approximately \$181 million in 1988. The increased revenues in both years exclusive of the translation impact were due to increased volume in the air conditioning and elevator businesses as well as increased service revenues in the elevator business.

In 1989, 85% of the Industrial Products segment revenues were from the automotive industry (77% in 1988 and 52% in 1987); 10% and 38% of 1988 and 1987 revenues, respectively, were from wire and cable products and the remainder in all years were in other markets. This segment's revenues decreased \$34.2 million, or 2%, in 1989 and decreased \$748.1 million, or 28%, in 1988. In February 1988, the Corporation sold its Essex subsidiary (wire and cable business). Excluding Essex, this segment's 1989 revenues would have increased \$154.8 million, or 9%, primarily as a result of increased sales to the automotive industry. Excluding Essex, revenues for 1988 would have approximated 1987 revenues.

Financing revenues and other income, net:

decreased 57% or \$293.4 million from 1988 to 1989;
increased 95% or \$251.8 million from 1987 to 1988.

Financing revenues and other income, net, exclusive of amounts allocated to segment operating profit, decreased \$211.0 million in 1989 and increased \$184.6 million in 1988.

The primary reasons for the 1988 increase and the 1989 decline are 1988 pretax gains aggregating approximately \$235 million on the sales of the Corporation's leasing subsidiaries, Essex

subsidiary and its investment in Telefunken Electronic GmbH, a West German joint venture. See Note 3 in the accompanying financial statements.

Cost of goods and services sold as a percent of sales:

decreased 1% from 1988 to 1989;
increased 1% from 1987 to 1988.

Cost of goods and services sold as a percent of sales increased in 1988 and declined in 1989 primarily as a result of the inclusion of the 1988 restructuring charge of \$148.8 million. Exclusive of the restructuring charge, cost of sales as a percent of sales would have remained constant in all periods presented.

Research and development expenses increased:

3% or \$24.2 million from 1988 to 1989;
6% or \$53.6 million from 1987 to 1988.

Research and development expenditures in 1989 and 1988, before partial sponsorship funding from customers and suppliers, were 32% and 4% higher than in 1988 and 1987, respectively. The primary reason for the increase in both periods was higher expenditures in the Power segment on advanced engine models. Partial sponsorship funding from customers and suppliers in certain advanced commercial and military aircraft engine programs aggregating \$304 million, \$21 million and \$38 million in 1989, 1988 and 1987, respectively, have been applied as reductions of research and development expenses. The large increase in partial sponsorship funding in 1989 was largely due to increased supplier participation fees related to advanced commercial engines (\$72 million) and customer participation in military engine development (\$211 million).

Selling, service and administrative expenses increased:

7% or \$188.3 million from 1988 to 1989;

6% or \$154.2 million from 1987 to 1988.

Selling, service and administrative expenses as a percent of sales have remained relatively constant in all periods presented. The 1989 increase is a result of the higher level of sales and increased volume across all business segments discussed above, offset in part by the sale in February 1988 of the Corporation's Essex subsidiary whose expenses are included to the date of sale. The primary reasons for the 1988 increase are the effects of changing foreign exchange rates upon the conversion of expenses of non-U.S. subsidiaries, and increased selling and administrative expenses in the air conditioning business, offset in part by the sale of the Corporation's Essex subsidiary.

Operating profit (after restructuring charges):

increased 27% or \$342.7 million from 1988 to 1989;

decreased 9% or \$122.2 million from 1987 to 1988.

Operating profits (losses) (before interest expense and general corporate expenses) of the Corporation's principal business segments for the three years ended December 31 were:

In Millions of Dollars	1989	1988	1987
Power	\$946.5	\$685.2	\$687.9
Flight Systems	\$ 55.7	\$ (15.4)	\$ 97.0
Building Systems	\$481.4	\$409.0	\$396.6
Industrial Products for the Automotive and Other Industries	\$157.8	\$216.7	\$236.1

The operating profits (losses) included in the table above reflect the effects of restructuring actions resulting in a charge to 1988 operating profits of \$148.8 million (see Note 2 in the accompanying financial statements). The restructuring charges included provisions to re-baseline major radar contracts at Norden Systems, charges to write-off capital equipment which became excess to Norden's needs (aggregating \$115.2 million) and, at several operating units, costs of relocation of some operations and of personnel reductions (\$33.6 million). The objective of the employee severance programs was to reduce costs and improve the Corporation's competitive position.

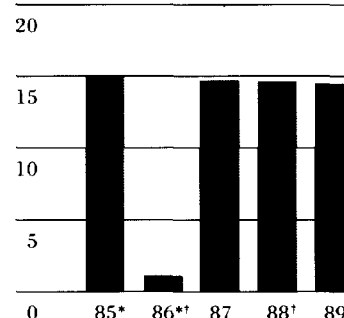
Operating profit before restructuring charges increased \$193.9 million in 1989 and \$26.6 million in 1988. For purposes of the analytical discussion presented in the following paragraphs, the operating profits excluding the restructuring and employee severance charges in 1988 were:

In Millions of Dollars	1989	1988	1987
Power	\$946.5	\$713.8	\$687.9
Flight Systems	\$ 55.7	\$104.8	\$ 97.0
Building Systems	\$481.4	\$409.0	\$396.6
Industrial Products for the Automotive and Other Industries	\$157.8	\$216.7	\$236.1

Power segment operating profits increased \$232.7 million, or 33%, in 1989. The increase was a result of the increased revenues discussed above, increased partial sponsorship funding of research and development on advanced commercial engines and the effects of cost reduction programs. Operating profits increased \$25.9 million, or 4%, in 1988. The main reasons for the increased profitability were the increased volume discussed above, a cancellation settlement of a foreign military engine order and a profit realized on the sale of notes received in connection with the 1987 sale of the Corporation's Elliott division. These increases were offset to some extent by lower profit in the general aviation business, which despite increased volume was adversely affected by lower margins resulting from adverse foreign exchange rates.

**Return on Equity
(After Tax)**

Percent

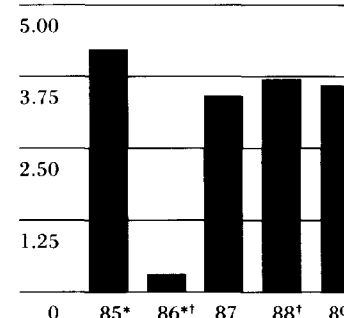


* Continuing operations

† Includes the restructuring provisions discussed on page 33.

**Return on Sales
(After Tax)**

Percent



* Continuing operations

† Includes the restructuring provisions discussed on page 33.

Operating results of the Flight Systems segment decreased \$49.1 million, or 47%, in 1989. The helicopter business was adversely impacted by inventory write-offs with lower royalty income being partially offset by a participation fee. Norden continued to operate at a loss reflecting continuing losses associated with performance of certain fixed price development contracts, repositioning the business and period costs in excess of gross margin levels. The Corporation continues to monitor the activities at Norden and to take such actions as are prudently appropriate to position Norden for the future. In April 1989, Norden was notified by General Dynamics that Norden was terminated as a sub-contractor on the A12 program. Although the full impact of the termination is not yet determinable, the Corporation believes that the termination will have no material adverse impact on the Corporation's results of operations. The Corporation's Hamilton Standard Division produced substantially improved operating results which somewhat offset the poor performance of the other operating units in this segment. Operating profits in this segment increased \$7.8 million, or 8%, in 1988. The increased profitability resulted from improved operating results at the Hamilton Standard Division and the helicopter business, which benefitted from increased royalty income, increased units sold and improved margins. These improvements were substantially offset by operations at Norden.

Building Systems segment operating profit increased \$72.4 million, or 18%, in 1989. The reason for the improvement was increased profitability in the elevator and air conditioning businesses primarily as a result of the higher volume discussed above and increased margins in the elevator business. The profitability increase in the air conditioning business occurred despite continuing intense competition in that business. The increase in operating profit of \$12.4 million, or 3%, in 1988 was primarily a result of increased profitability in the elevator business. Profitability in the air conditioning business was adversely affected by continued competitive pressure on margins and increased new-product development costs. The impact of these items was partially offset by a gain on the sale of certain real estate.

Operating profits in the Industrial Products segment declined \$58.9 million, or 27%, in 1989. The decline was caused by losses incurred by Sheller-Globe (see Note 3 in the accompanying financial

statements), the absence of operating profits of the Corporation's Essex subsidiary which was sold in February 1988 and lower operating profits in the automotive business as a result of the general softness in the U.S. automobile market during the second half of 1989 offset to some extent by gains on sales of certain small business units. Operating profits of Essex are included to the date of disposition. Operating profits decreased \$19.4 million, or 8%, in 1988. The principal reason for the decline in this segment was the sale of Essex, offset in part by increased profitability in the Corporation's automotive business.

Interest expense:

increased 11% or \$34.4 million from 1988 to 1989;
decreased 6% or \$19.6 million from 1987 to 1988.

Interest expense was \$346.5 million and \$312.1 million in 1989 and 1988, respectively. The increase in 1989 was a result of higher net borrowings offset slightly by lower short-term interest rates. The increased borrowings were primarily due to the acquisition of treasury shares in connection with the Employee Stock Ownership Plan discussed below and other investing activities. The decrease in 1988 was a result of lower average borrowings and higher amounts of interest capitalized on fixed assets constructed, offset to some extent by slightly higher rates.

The weighted-average interest rate paid on the Corporation's short-term borrowings in 1989 was 12.9% (13.7% in 1988 and 9.4% in 1987), and the average composite rate for short-term borrowings and long-term debt for 1989 was 10.8% (10.9% in 1988 and 9.5% in 1987). The average rate applicable to debt outstanding at December 31, 1989 was 9.3% for the short-term borrowings, and the average composite rate including long-term debt was 9.1%. Average short-term interest rates are significantly affected by foreign subsidiaries' borrowings, including those in highly inflationary economies.

Net income increased:

\$43.0 million from 1988 to 1989;

\$67.4 million from 1987 to 1988.

The increases in 1989 and 1988 are a net result of the items discussed above as well as a reduction in 1988 in the Corporation's effective income tax rate from 41.9% in 1987 to 39.5% in 1988. The decline in the effective income tax rate is in large part due to the 1988 reduction in the federal statutory rate from 40% to 34%.

The statutory tax rate decrease to 34% in 1988, and from 46% to 40% in 1987, will give rise to adjustments in the deferred tax accounts under Financial Accounting Standard No. 96, "Accounting for Income Taxes," issued in December 1987 and originally requiring adoption no later than 1990. The Financial Accounting Standards Board has delayed the required adoption to no later than January 1, 1992 and has stated the Board will review the Standard. The Corporation has therefore not made a decision as to the date it will adopt FAS 96. If the Corporation had elected early adoption of FAS 96 as of January 1, 1989 and elected to restate prior periods' financial statements as permitted by the Standard, 1987 and 1988 earnings would be reduced by approximately \$180 million and \$30 million, respectively. There would have been no material impact on 1989 earnings. Of the 1987 charge to earnings, approximately \$155 million represents the cumulative effect of the adoption of the Standard. The provisions of FAS 96 as currently written will have potential for producing, under certain conditions, significant distortion in the Corporation's income tax provision and effective tax rate from year to year.

Financial Position

Management assesses the Corporation's liquidity in terms of its overall ability to mobilize cash to fund its operations. Of particular importance in the management of liquidity are cash flows generated from operating activities including levels of accounts receivable, inventories and accounts payable; as well as fixed asset additions; adequate bank lines of credit; and financial flexibility to attract long-term capital on satisfactory terms.

Set forth below is selected key cash flow data from the Consolidated Statement of Cash Flows:

In Millions of Dollars	1989	1988	1987
Net Cash Flows from Operating Activities	\$ 1,176.1	\$ 736.7	\$ 1,119.1
Purchase of Fixed Assets	\$(1,023.3)	\$(875.3)	\$(875.3)
Acquisition of Business Units	(388.4)	—	—
Dispositions of Business Units	64.0	869.6	1,119.1
Other Investing Activities	53.4	69.2	—
Net Cash Flows from Investing Activities	\$(1,294.3)	\$ 63.5	\$(625.6)
Net Cash Flows from Financing Activities	\$ 186.2	\$(929.4)	\$(425.6)

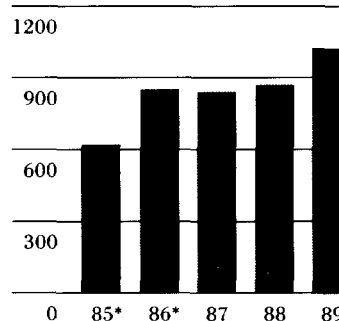
As indicated above, cash flows from operating activities totaled \$3,095.8 million for the three years ended December 31, 1989.

Receivables and inventories increased an aggregate \$1,280 million from 1987 through 1989 principally from increased levels in all of the Corporation's business segments and other factors.

Investing cash flows include \$367 million for the 1989 completion of the acquisition of Sheller-Globe, including debt acquisition cash. In connection with the acquisition, the Corporation refinanced an additional \$252.5 million of Sheller debt.

Capital Expenditures

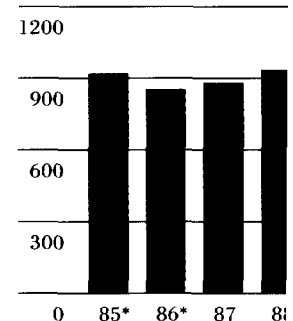
\$ Millions



* Continuing operations

Research and Development Expenditures

\$ Millions



* Continuing operations

The substantial fixed asset additions during the period 1987 through 1989 have been necessary to increase productivity, to keep the Corporation's facilities modern and to provide for expansion of some product lines. The great majority of these expenditures were for machinery and equipment and were necessary to maintain and enhance the Corporation's competitive position and were made across all business segments (see Consolidated Summary of Business Segment Financial Data on page 51 of the Annual Report). Funds used for financing activities during the period included dividends to preferred and common shareowners, and the purchase of Common Stock of the Corporation. During 1988, the Corporation redeemed \$279 million of long-term debt.

To meet its net financing requirements, during the three-year period ended December 31, 1989, the Corporation adjusted its level of short-term borrowings as required and issued long-term debt when conditions were considered favorable. The results of the foregoing activities upon the Corporation's financial structure are shown in the following tabulation:

Millions of Dollars	1989	1988	1987
Short-term borrowings and current portion of long-term debt	\$1,573.6	\$ 585.5	\$ 773.3
Long-term debt	\$1,959.6	\$1,642.8	\$2,229.6
Shareowners' equity	\$4,740.3	\$4,823.4	\$4,292.6
Debt to total capitalization	43%	32%	41%

The Corporation's ratio of debt to total capitalization reflects an 11 percentage point increase from 1988. The 1989 ratio was increased as a result of the acquisition of Sheller-Globe and the treasury stock acquisition in connection with the Employee Stock Ownership Plan discussed below. Exclusive of these transactions the ratio would have decreased slightly from 1988 to 1989.

In the second quarter of 1989, the Corporation's Board of Directors approved an Employee Stock Ownership Plan, or ESOP. See Note 12 in the accompanying financial statements. The ESOP acquired 10.2 million shares of a new convertible preferred stock, representing approximately eight percent of the equity ownership of the Corporation in exchange for promissory notes aggregating \$660 million issued to the Corporation by the ESOP. In connection with the ESOP, the Corporation also repurchased 10.4 million shares of its Common Stock for a total cost of \$561.5 million. The effect of the ESOP and related transactions was to reduce fully diluted earnings per share by \$.05 for 1989.

The ESOP is in the process of arranging permanent financing which will be used to repay the notes to the Corporation. The debt will be guaranteed by the Corporation and will be recorded in the long-term debt section of the Corporation's consolidated balance sheet with a corresponding offset to convertible preferred stock.

The financing is expected to be completed during the first quarter of 1990. It is anticipated that the proceeds will be used to reduce borrowings.

The acquisition of Sheller-Globe and the establishment of the ESOP and related transactions had the effect of increasing the Corporation's debt to total capitalization ratio but are not expected to impair the Corporation's ability to borrow funds as evidenced by the reaffirmation of the Corporation's Aa3 and AA- debt ratings by both Moody's Investor Services and Standard & Poor's, respectively.

In October 1989, the Corporation filed a "shelf" registration with the Securities and Exchange Commission, covering up to \$500 million of unsubordinated, non-convertible and unsecured medium and long-term debt securities. In November 1989, the Corporation sold \$300 million of its 8 7/8% Debentures due November 15, 2019, the proceeds of which were used to repay short-term borrowings and for other corporate purposes.

At December 31, 1989, the Corporation had credit commitments by banks totaling \$1.05 billion under a Revolving Credit Agreement through January 1, 1993. At December 31, 1989, there were no borrowings under the Revolving Credit Agreement. Long-term financing will continue to be considered in the future if conditions are advantageous, and in that regard, under an effective Registration Statement discussed above on file with the Securities and Exchange Commission at December 31, 1989, up to \$235 million of medium-term and long-term debt of the Corporation might be issued.

In addition to the funds requirements discussed above, the Corporation had commitments to finance or arrange financing for customers at December 31, 1989 of approximately \$3 billion of commercial aircraft, of which \$600 million may be required to be disbursed in 1990. See Note 13 in the accompanying financial statements.

The Corporation is contemplating the sale of certain operating units of its automotive business. It is anticipated the sale of these units will be completed during 1990 and will provide cash flow to the Corporation which will be available to reduce borrowings and for general corporate purposes.

The Corporation is involved in a number of environmental matters at various sites, where other parties may also be involved. The nature of these matters makes it difficult to estimate the timing and amount of future expenditures for remedial measures. The Corporation incurred costs, including capital expenditures, of \$75 million, \$70 million and \$50 million in 1989, 1988 and 1987, respectively, with respect to these matters including provisions for future costs of cleanup pertaining to formerly owned businesses. In addition, the Corporation has instituted legal proceedings against its insurers asserting insurance coverage for pollution costs. These proceedings are in the early stages and are expected to last several years. No prediction as to the outcome of the proceedings can be made at this time.

Like many defense contractors, the Corporation and certain of its units continue to be the subject of ongoing criminal investigations in connection with their activities as a government contractor, including the major grand jury investigation announced in 1988, known as "Operation Ill Wind," which involves defense contractors and certain of their consultants, executives and employees.

As part of the latter investigation, the Corporation was one of a number of defense contractors that had premises searched at several of its units and received grand jury subpoenas. The Government's criminal investigation has led to prosecutions of certain contractors and is continuing with respect to other contractors, including Pratt & Whitney and Norden. In connection with this investigation, in December 1989, two of Norden's former employees pleaded guilty to violations of federal law.

If the Corporation were charged with wrongdoing as a result of any of these investigations, the Corporation or its business units could be suspended from eligibility for bidding on or for awards of new government contracts. Moreover, contracts found tainted by fraud could be voided, and the Corporation, if convicted, could be fined and debarred as a government contractor for a period generally not to exceed three years.

* * *

Management believes that available sources of funds, indicated above, should be adequate to meet its presently foreseeable cash requirements.

Comparative Stock Data

United Technologies Corporation

	1989			1988		
	High	Low	Dividend	High	Low	Dividend
Common Stock						
First Quarter	46 ³ / ₈	39 ⁷ / ₈	\$.40	42 ¹ / ₂	33	\$.35
Second Quarter	53 ¹ / ₂	45 ⁵ / ₈	.40	41 ³ / ₄	35 ¹ / ₄	.40
Third Quarter	57 ³ / ₈	49 ⁷ / ₈	.40	40 ¹ / ₄	34 ⁷ / ₈	.40
Fourth Quarter	56 ⁷ / ₈	50 ¹ / ₄	.40	42 ⁵ / ₈	38 ¹ / ₈	.40

The Corporation's Common Stock is listed on the New York Stock Exchange.
The high and low prices are based on the Composite Tape.
There were 39,500 Common Stock shareowners of record at December 31, 1989.

Five-Year Summary

United Technologies Corporation

In Millions of Dollars
(except per share amounts)

1989

1988

1987

1986

1985

For the Year

Sales from continuing operations	\$19,532.1	\$18,000.1	\$17,170.2	\$15,669.2	\$14,991.7
Percent to United States					
Government	24%	26%	27%	28%	30%
Cost of goods and services sold	\$14,382.2	\$13,486.0	\$12,665.5	\$12,391.0	\$10,907.7
Research and development	\$ 956.6	\$ 932.4	\$ 878.8	\$ 852.8	\$ 916.2
Selling, service and administrative	\$ 2,810.8	\$ 2,622.5	\$ 2,468.3	\$ 2,298.1	\$ 2,012.9
Interest expense	\$ 346.5	\$ 312.1	\$ 331.7	\$ 284.7	\$ 249.8
Income taxes	\$ 497.8	\$ 460.1	\$ 458.0	\$ 59.9	\$ 446.1
Income from continuing operations	\$ 702.1	\$ 659.1	\$ 591.7	\$ 48.1	\$ 636.4
Net Income	\$ 702.1	\$ 659.1	\$ 591.7	\$ 72.7	\$ 312.7
Earnings applicable to common stock	\$ 687.3	\$ 659.1	\$ 591.7	\$ 32.7	\$ 259.4
Earnings per share:					
Continuing operations:					
Primary	\$ 5.34	\$ 5.05	\$ 4.52	\$.07	\$ 4.76
Fully diluted	\$ 5.20****	\$ 5.05	\$ 4.52	\$.36*	\$ 4.58
Net Income:					
Primary	\$ 5.34	\$ 5.05	\$ 4.52	\$.27	\$ 2.12
Fully diluted	\$ 5.20****	\$ 5.05	\$ 4.52	\$.54*	\$ 2.25**
Cash dividends on common stock	\$ 205.7	\$ 202.5	\$ 183.4	\$ 170.2	\$ 171.7
Per share	\$ 1.60	\$ 1.55	\$ 1.40	\$ 1.40	\$ 1.40
Average number of shares of Common Stock outstanding:					
Primary	128,693,058	130,608,493	131,026,367	122,795,258	122,538,718
Fully converted	133,839,528	130,608,493	131,026,367	133,694,697	138,997,346
Return on sales, after tax	3.6%	3.7%	3.4%	0.3%***	4.2%***
Asset turnover (sales/assets)	1.53	1.49	1.47	1.47	1.40
Return on assets, after tax	5.5%	5.4%	5.1%	0.5%***	5.9%***
Return on equity, after tax	14.5%	14.6%	14.7%	1.8%	7.4%

* In the third quarter of 1986, substantially all the shares of the \$2.55 Preferred Stock were converted into Common Stock. Had the conversions of those securities taken place on January 1, 1986, the primary earnings per share for 1986 would have been \$.36 based on income from continuing operations and \$.54 based on net income. In accordance with the provisions of Accounting Principles Board Opinion No. 15, the fully diluted earnings per share have been calculated as though such conversions had taken place at the beginning of 1986, which has the effect of increasing fully diluted earnings per share over the comparable primary amount.

** The fully diluted net income per share for 1985 is higher than the comparable primary earnings per share amount because of the required inclusion of securities which are dilutive to earnings per share on income from continuing operations but anti-dilutive to earnings per share on net income.

*** Based on income from continuing operations.

**** As discussed in Note 1 in the accompanying financial statements, the Corporation issued Series A ESOP Convertible Preferred Stock in 1989, thereby requiring the presentation of fully diluted earnings per share.

Five-Year Summary

United Technologies Corporation

In Millions of Dollars
(except per share amounts)

1989

1988

1987

1986

1985

At Year End

Net working capital	\$ 2,130.7	\$ 3,040.5	\$ 2,880.9	\$ 2,658.5	\$ 2,948.0
Current asset ratio	1.3 to 1	1.6 to 1	1.6 to 1	1.6 to 1	1.7 to 1
Total assets	\$14,598.2	\$12,748.3	\$12,873.5	\$11,962.5	\$11,499.0
Short-term borrowings	\$ 1,281.0	\$ 323.8	\$ 702.0	\$ 870.5	\$ 684.1
Long-term debt, including current portion	\$ 2,252.2	\$ 1,904.5	\$ 2,300.9	\$ 2,230.1	\$ 1,810.2
Debt to total capitalization	43%	32%	41%	45%	36%
Net worth	\$ 4,740.3	\$ 4,823.4	\$ 4,292.6	\$ 3,803.1	\$ 4,373.3
Common shareowners' equity	\$ 4,739.4	\$ 4,822.4	\$ 4,291.0	\$ 3,801.4	\$ 3,848.8
Equity per common share	\$ 39.14	\$ 36.88	\$ 32.90	\$ 29.14	\$ 31.32
Unfilled orders	\$20,125.0	\$16,875.0	\$14,700.0	\$13,650.0	\$11,725.0
Number of employees:					
United States	115,100	109,900	115,200	120,600	116,300
International:					
Europe	38,300	33,400	34,300	34,600	32,700
Other	48,000	43,500	40,500	38,300	35,800
Total	201,400	186,800	190,000	193,500	184,800
Number of shareowners	39,800	42,900	45,600	49,000	60,900

Notes:

Cost of goods sold in 1988 and 1986 includes pretax charges of \$148.8 million and \$592.6 million, respectively, related to restructuring and employee severance plans. See Note 2 of Notes to Financial Statements. Also in 1988, the Corporation sold stock of certain of its finance subsidiaries, its Essex subsidiary and its share of a semiconductor joint venture resulting in pretax gains of \$235.3 million. See Note 3 of Notes to Financial Statements.

Effective January 1, 1986, the Corporation adopted Financial Accounting Standard No. 87, "Employers' Accounting for Pensions" (FAS 87). The effect of adopting FAS 87 was to increase 1986 net income by \$49.3 million (\$.40 primary earnings per share and \$.37 fully diluted earnings per share).

In August 1985, the Corporation completed the sale of its Inmont subsidiary. In October 1985, the Board of Directors approved a plan to terminate the operations of its Mostek subsidiary and its telecommunications business. Inmont, Mostek and the telecommunications business have been treated as discontinued businesses for financial reporting purposes.

Equity per common share is based on shares outstanding at each year end.

Management's Responsibility for Financial Statements

The financial statements of United Technologies Corporation and consolidated subsidiaries, and all other information presented in this Annual Report, are the responsibility of the management of the Corporation. The financial statements have been prepared in accordance with generally accepted accounting principles.

Management is responsible for the integrity and objectivity of the financial statements, including estimates and judgments reflected in them. It fulfills this responsibility primarily by establishing and maintaining accounting systems and practices adequately supported by internal accounting controls. These controls include the selection and training of management and supervisory personnel; an organization structure providing for delegation of authority and establishment of responsibilities; communication of requirements for compliance with approved accounting, control and business practices throughout the organization; business planning and review; and a program of internal audit. Management believes the internal accounting controls in use provide reasonable assurance that the Corporation's assets are safeguarded, that transactions are executed in accordance with management's authorizations, and that the financial records are reliable for the purpose of preparing financial statements.

Independent accountants are elected annually by the Corporation's shareowners to audit the financial statements in accordance with generally accepted auditing standards. Their report appears in this Annual Report. Their audits, as well as those of the Corporation's internal audit department, include a review of internal accounting controls and selective tests of transactions.

The Audit Review Committee of the Board of Directors, consisting of five directors who are not officers or employees of the Corporation, meets regularly with management, the independent accountants and the internal auditors, to review matters relating to financial reporting, internal accounting controls and auditing.

Report of Independent Accountants

To the Shareowners of United Technologies Corporation

In our opinion, the accompanying consolidated balance sheet and the related consolidated statements of income, of changes in shareowners' equity and of consolidated cash flows present fairly, in all material respects, the financial position of United Technologies Corporation and its subsidiaries at December 31, 1989 and 1988, and the results of their operations and their cash flows for each of the three years in the period ended December 31, 1989, in conformity with generally accepted accounting principles. These financial statements are the responsibility of the Corporation's management; our responsibility is to express an opinion on these financial statements based on our audits. We conducted our audits of these statements in accordance with generally accepted auditing standards which require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for the opinion expressed above.



One Financial Plaza
Hartford, Connecticut
January 18, 1990

Consolidated Statement of Income

United Technologies Corporation

In Millions of Dollars (except per share amounts)	Years Ended December 31,		
	1989	1988	1987
Revenues			
Sales	\$19,532.1	\$18,000.1	\$17,170.2
Financing revenues and other income, less other deductions	224.4	517.8	266.0
	\$19,756.5	\$18,517.9	\$17,436.2
Costs and Expenses			
Cost of goods and services sold	\$14,382.2	\$13,486.0	\$12,665.5
Research and development	956.6	932.4	878.8
Selling, service and administrative	2,810.8	2,622.5	2,468.3
Interest	346.5	312.1	331.7
	\$18,496.1	\$17,353.0	\$16,344.3
Income before income taxes and minority interests	\$ 1,260.4	\$ 1,164.9	\$ 1,091.9
Income taxes	497.8	460.1	458.0
Income before minority interests	\$ 762.6	\$ 704.8	\$ 633.9
Less — Minority interests in subsidiaries' earnings	60.5	45.7	42.2
Net Income	\$ 702.1	\$ 659.1	\$ 591.7
Preferred Stock Dividend Requirement	\$ 14.8	\$ —	\$ —
Earnings Applicable to Common Stock	\$ 687.3	\$ 659.1	\$ 591.7
Per Share of Common Stock:			
Primary	\$5.34	\$5.05	\$4.52
Fully Diluted	\$5.20	\$5.05	\$4.52

See accompanying Notes to Financial Statements

Consolidated Balance Sheet

United Technologies Corporation

December 31,

In Millions of Dollars

1989

1988

Assets

Cash and short-term cash investments	\$ 266.5	\$ 242.6
Accounts receivable	3,455.5	2,785.6
Future income tax benefits	597.6	642.4
Inventories and contracts in progress	5,968.8	6,269.7
Less — Progress payments and billings on contracts in progress	(2,057.6)	(2,068.3)
Prepaid expenses	276.0	116.6
Total Current Assets	\$ 8,506.8	\$ 7,988.6
Accounts, notes and leases receivable, due after one year	\$ 437.9	\$ 340.6
Other investments	\$ 343.9	\$ 334.8
Fixed Assets, at cost:		
Land	\$ 137.7	\$ 119.2
Buildings and improvements	2,073.9	1,913.6
Machinery, tools and equipment	4,856.1	4,277.7
Under construction	636.5	489.0
	\$ 7,704.2	\$ 6,799.5
Less — Accumulated depreciation and amortization	(3,752.3)	(3,392.9)
	\$ 3,951.9	\$ 3,406.6
Deferred Charges:		
Costs in excess of net assets of acquired companies (net of amortization)	\$ 668.0	\$ 260.9
Prepaid pension costs and other	689.7	416.8
	\$ 1,357.7	\$ 677.7
Total Assets	\$14,598.2	\$12,748.3

Liabilities and Shareowners' Equity

Short-term borrowings	\$ 1,281.0	\$ 323.8
Accounts payable	1,869.0	1,545.8
Accrued salaries, wages and employee benefits	768.1	688.8
Other accrued liabilities	1,358.0	1,201.5
Long-term debt — currently due	292.6	261.7
Income taxes currently payable	283.6	351.3
Advances on sales contracts	523.8	575.2
Total Current Liabilities	\$ 6,376.1	\$ 4,948.1
Deferred income taxes	\$ 404.4	\$ 371.0
Long-term debt	\$ 1,959.6	\$ 1,642.8
Other long-term liabilities	\$ 841.4	\$ 726.7
Commitments and contingent liabilities (Note 13)		
Minority interests in subsidiary companies	\$ 276.4	\$ 236.3
Series A ESOP Convertible Preferred Stock, \$1 par value (Authorized— 20,000,000 shares) Outstanding—10,153,846 shares (Note 12)	\$ 660.0	\$ —
ESOP notes receivable (Note 12)	(660.0)	—
Shareowners' Equity:		
Capital Stock:		
Preferred Stock, \$1 par value (Authorized — 250,000,000 shares) Issued and Outstanding — 9,036 and 9,053 shares, respectively	\$.9	\$.9
Common Stock, \$5 par value (Authorized — 500,000,000 shares) Issued — 132,093,724 and 130,764,424 shares, respectively	1,772.7	1,720.5
Deferred foreign currency translation adjustments	(36.0)	(14.0)
Retained earnings	3,596.4	3,116.0
Less cost of 11,002,100 common stock shares in treasury	(593.7)	—
Total Shareowners' Equity	\$ 4,740.3	\$ 4,823.4
Total Liabilities and Shareowners' Equity	\$14,598.2	\$12,748.3

See accompanying Notes to Financial Statements

Consolidated Statement of Cash Flows

United Technologies Corporation

Years Ended December 31,

In Millions of Dollars

	1989	1988	1987
Cash flows from operating activities:			
Net income	\$ 702.1	\$ 659.1	\$ 591.7
Adjustments to reconcile net income to net cash flows from operating activities:			
Depreciation	590.9	536.4	505.1
Amortization of goodwill	29.3	25.5	24.2
(Increase) decrease in:			
Current and long-term accounts, notes and leases receivable	(595.4)	(138.8)	(44.2)
Inventories, net of progress payments	317.3	(377.2)	(448.8)
Prepaid expenses	(159.4)	(15.3)	5.8
Other investments—products under lease	(48.6)	(44.2)	(87.7)
Increase (decrease) in:			
Accounts and taxes payable, and accrued liabilities	233.4	276.5	262.6
Deferred taxes and future income tax benefits	103.4	(81.8)	163.1
Advances on sales contracts	(48.6)	75.2	136.2
Minority interests in subsidiaries' earnings	60.5	45.7	42.2
Gains from disposition of business units	(19.9)	(235.3)	—
Other	11.1	10.9	32.8
Net Cash Flows from Operating Activities	\$ 1,176.1	\$ 736.7	\$ 1,183.0
Cash flows from investing activities:			
Purchase of fixed assets	\$(1,023.3)	\$ (875.3)	\$ (839.0)
Sale of fixed assets	61.0	122.5	63.9
Other investments—other companies	(9.4)	(53.3)	(33.6)
Acquisition of business units	(388.4)	—	—
Dispositions of business units	64.0	869.6	169.2
Other	1.8	—	(10.8)
Net Cash Flows from Investing Activities	\$(1,294.3)	\$ 63.5	\$ (650.3)
Cash flows from financing activities:			
Issuance of long-term debt	\$ 632.8	\$ 34.4	\$ 60.8
Repayments of long-term debt	(307.7)	(373.0)	(152.4)
Increase (decrease) in short-term borrowings	703.0	(363.8)	(164.9)
Repurchase of Common Stock	(593.7)	—	(41.8)
Common Stock issued for employee stock plans and other	52.2	8.7	38.2
Dividends paid on Common and Preferred Stocks	(227.4)	(202.5)	(183.5)
Other	(73.0)	(33.2)	(12.1)
Net Cash Flows from Financing Activities	\$ 186.2	\$ (929.4)	\$ (455.7)
Effect of foreign exchange rate changes on cash and short-term cash investments	\$ (44.1)	\$ (58.0)	\$.2
Net Increase (Decrease) in Cash and Short-Term Cash Investments	\$ 23.9	\$ (187.2)	\$ 77.2

Supplemental Disclosures:

Income taxes paid in 1989, 1988 and 1987 totaled \$419.8 million, \$460.8 million and \$72.7 million, respectively. Total interest paid, net of amounts capitalized, was \$331.7 million, \$305.7 million and \$305.2 million in 1989, 1988 and 1987, respectively.

In 1989, the Corporation issued 10.2 million shares of a new series of preferred stock to a newly established Employee Stock Ownership Plan (ESOP) in exchange for promissory notes aggregating \$660 million. See Note 12. The Corporation also refinanced \$252.5 million of debt in connection with the acquisition of Sheller-Globe. See Note 3.

In 1988, the Corporation realized cash of \$22 million on the sale of notes and common stock warrants received as part of the 1987 sale of a business unit.

In 1987, the Corporation received \$104.9 million in three installment payments on notes received as part of the 1986 sale of a wholly-owned real estate subsidiary.

See accompanying Notes to Financial Statements

Consolidated Statement of Changes In Shareowners' Equity

Three Years Ended December 31, 1989

Balance December 31, 1986

Issued under employee incentive plans, and related tax benefit (1,148,953 shares of Common Stock, net of 317,546 shares purchased and reissued)

Redemption and purchase of 1,159 shares of Preferred Stock

Purchase of 1,184,200 shares of Common Stock

Deferred foreign currency translation adjustments:

Translation and hedging adjustments, net of income tax benefits of \$69.0 million

Sale of foreign investments

Net income

Dividends on—Common Stock (\$1.40 per share)

Balance December 31, 1987

Issued under employee incentive plans, and related tax benefit (351,116 shares of Common Stock, net of 87,565 shares purchased and reissued)

Redemption and purchase of 5,719 shares of Preferred Stock

Deferred foreign currency translation adjustments:

Translation and hedging adjustments, net of income taxes of \$18.7 million

Sale of foreign investments

Net income

Dividends on—Common Stock (\$1.55 per share)

Balance December 31, 1988

Issued under employee incentive plans, and related tax benefit (1,329,300 shares of Common Stock, net of 284,921 shares purchased and reissued)

Redemption and purchase of 17 shares of Preferred Stock

Purchase of 11,002,100 shares of Common Stock

Deferred foreign currency translation adjustments:

Translation and hedging adjustments, net of income tax benefits of \$2.9 million

Sale of foreign investments

Net income

Dividends on—Common Stock (\$1.60 per share)

—ESOP Preferred Stock (\$4.80 per share), net of income tax benefits of \$9.5 million

Balance December 31, 1989

See accompanying Notes to Financial Statements

In Millions of Dollars

\$4.50 Preferred Stock	Common Stock	Deferred Translation Adjustments	Treasury Stock	Retained Earnings
\$1.6	\$1,684.7	\$(164.5)	\$ —	\$2,281.3
	41.6			(3.4)
(.1)	(15.5)			(26.3)
		74.4		
		10.5		
				591.7
				(183.4)
\$1.5	\$1,710.8	\$ (79.6)	\$ —	\$2,659.9
	9.7			(.5)
(.6)				
		61.7		
		3.9		
				659.1
				(202.5)
\$.9	\$1,720.5	\$ (14.0)	\$ —	\$3,116.0
	52.2			(1.2)
—			(593.7)	
		(23.3)		
		1.3		
				702.1
				(205.7)
				(14.8)
\$.9	\$1,772.7	\$ (36.0)	\$(593.7)	\$3,596.4

Notes to Financial Statements

Note 1

Summary of Accounting Principles: The consolidated financial statements include the accounts of the Corporation and all of its subsidiaries. International operating subsidiaries are included generally on the basis of fiscal years ending November 30.

Sales under government and commercial fixed-price contracts and government fixed-price-incentive contracts are recorded at the time deliveries are made or, in some cases, on a percentage of completion basis. Sales under cost-reimbursement contracts are recorded as work is performed and billed. Sales of commercial aircraft engines sometimes require significant participation by the Corporation in aircraft financing arrangements; when appropriate such sales are accounted for as operating leases. Sales under elevator and escalator installation and modernization contracts are accounted for under the percentage of completion method. Service contract revenues are recorded as sales when earned.

Inventories and contracts in progress are stated at the lower of cost or estimated realizable value. Inventories consist largely of raw materials and work in process. Materials in excess of requirements for contracts and orders currently in effect or anticipated have been eliminated. A considerable portion of the inventories is based on cost standards which are adjusted to reflect approximate current costs. The remainder of the inventories is stated either at average cost or at actual cost accumulated against specific contracts or orders or, in the case of a substantial portion of inventories in the building systems and industrial products businesses, at last-in, first-out (LIFO) cost. Manufacturing tooling costs are charged to inventories or to fixed assets depending upon their nature, general applicability and useful lives. Tooling costs included in inventory are charged to cost of sales based on usage, generally within two years after they enter productive use. All other manufacturing costs are allocated to current production; no such costs are deferred and assigned to future production.

Contracts in progress relate to elevator and escalator contracts and include standard cost of manufactured components, accumulated installation cost, and estimated earnings on uncompleted contracts.

Prospective losses, if any, on contracts are provided for when the losses become anticipated. Loss provisions are based upon any anticipated excess of inventoriable manufacturing or engineering cost and estimated warranty costs over the net revenue from the products contemplated by the specific order.

Provisions for depreciation of plant and equipment related to the Corporation's aerospace operations have generally been made on accelerated methods. Provisions for depreciation of other plant and equipment have generally been made on the straight-line method. Wherever possible, accelerated methods are used for income tax purposes. Generally, estimated useful lives used for financial statement depreciation purposes range from 30 to 50 years for buildings and improvements, from 8 to 20 years for machinery and equipment, and from 5 to 10 years for office equipment. Improvements to leased property are amortized over the life of the lease.

Research and development costs not specifically covered by contracts and those related to the Corporation sponsored share of research and development activity in connection with cost-sharing arrangements are charged against income as incurred. General and administrative expenses also are charged to income as incurred. Costs pertaining to fulfillment of the Corporation's warranty and service policies and product guarantees are estimated on the basis of past experience and current product performance and, where believed to be significant and reasonably predictable in amount, are accrued at the time products are sold.

Costs in excess of values assigned to the underlying net assets of acquired companies are included in deferred charges and are generally being amortized over periods ranging from 25 to 40 years.

Provisions for income taxes are based upon income and expenses recorded in accordance with the Corporation's regular accounting practices, and as shown in the financial statements. The income tax effects of differences in the time when income and expenses are reflected in accordance with such regular accounting practices and the time they are recognized for income tax purposes are shown in the balance sheet as future income tax benefits or as deferred income taxes, as appropriate.

Primary earnings per share computations are based on the average number of shares of Common Stock outstanding during the year. Fully diluted earnings per share reflect the maximum dilution of per share earnings which would have occurred if all the ESOP Convertible Preferred Stock of the Corporation had been converted as of the date of issue. Each share of the ESOP preferred stock is convertible into one share of Common Stock. A reduction in earnings available to common shares is required in the calculation of fully diluted earnings per share representing the Corporation's additional contribution to the ESOP to enable it to meet its debt repayment responsibilities were the preferred dividends not available for this purpose.

Current assets and current liabilities include items expected to be realized or liquidated during the next year. Short-term cash investments are highly liquid in nature and are considered cash equivalents within the requirements of Financial Accounting Standard No. 95, "Statement of Cash Flows."

Note 2

Restructuring and Employee Severance Plans: In 1988, the Corporation's Board of Directors approved restructuring actions at certain operating entities resulting in charges to cost of goods and services aggregating \$148.8 million. The restructuring charges included provisions to re-baseline major radar contracts at Norden Systems, charges to write-off capital equipment which became excess to Norden's needs and, at several operating units, costs of relocation of operations and of personnel reductions.

Note 3

Acquisition and Dispositions:

Acquisition:

In December 1988, the Corporation purchased an initial 46% equity interest in Sheller-Globe Corporation (Sheller). In the fourth quarter of 1989, the Corporation completed the acquisition of Sheller. Sheller designs, engineers, manufactures and distributes a wide range of components used as production and replacement parts in cars, trucks and other vehicles and specializes in interior components for such vehicles. The results of operations were accounted for under the equity method in 1989. Sheller's balance sheet has been consolidated in the Corporation's consolidated balance sheet at December 31, 1989. Goodwill recognized in the purchase is being amortized over 40 years. Pro forma presentation of the Corporation's earnings, as if the acquisition had been made on January 1 of the periods presented, would not be materially different from reported results.

Dispositions:

Included in the caption "Financing revenues and other income, less other deductions" in the accompanying Consolidated Statement of Income are gains realized by the Corporation on the sale of certain of its investments. In 1988, these gains resulted from the sale of stock in certain finance subsidiaries (\$98.8 million) discussed in Note 7,

the sale of its Essex subsidiary (\$95.1 million) and the sale of its share of Telefunken Electronic GmbH, a West German semiconductor joint venture (\$41.4 million).

Note 4

International Operations: A substantial portion of the Corporation's revenues and assets relate to international operations. The Corporation has significant manufacturing facilities in Canada, Italy, France, Japan, Spain, the United Kingdom and Germany and operations of lesser size in a number of other countries. At December 31, 1989, the investment (identifiable assets) in any single country other than the United States did not exceed 5% of the Corporation's total identifiable assets, except for investments in Canada which amounted to 7% of total identifiable assets. Amounts included in the accompanying consolidated financial statements associated with operations outside the United States consist of the following:

In Millions of Dollars	1989	1988	1987
Sales	\$6,064.6	\$5,278.6	\$4,712.7
Net income	\$ 321.6	\$ 229.6	\$ 251.9
Assets	\$4,178.4	\$3,776.1	\$3,912.5
Liabilities	\$2,271.2	\$2,230.7	\$2,191.6
Minority interests	\$ 273.5	\$ 233.6	\$ 216.7

The financial position and results of operations of substantially all of the Corporation's significant foreign subsidiaries are measured using local currency as the functional currency. The aggregate effects of translating the financial statements of these subsidiaries are deferred as a separate component of Shareowners' Equity.

The economies of Brazil and Mexico have been determined to be highly inflationary; accordingly, translation gains and losses are taken into income currently.

Earnings were credited or charged with foreign exchange gains (losses), including translation gains and losses of operations in highly inflationary economies, of \$(20.3) million, \$7.9 million and \$0.8 million in 1989, 1988 and 1987, respectively.

Note 5

Accounts, Notes and Leases Receivable: Allowances for doubtful accounts of \$96.6 million and \$106.5 million have been applied as a reduction of current accounts receivable at December 31, 1989 and 1988, respectively.

Current and long-term accounts receivable at December 31, 1989 and 1988 include approximately \$289 million and \$265 million, respectively, representing retainage under contract provisions and amounts which are not presently billable because of lack of funding or final prices or contractual documents under government contracts or for other reasons. These items are expected to be collected in the normal course of business. At December 31, 1988 the Corporation had sold \$190.5 million of accounts receivable to third parties without recourse.

Accounts, notes and leases receivable, due after one year, consist of the following at December 31:

In Millions of Dollars	1989	1988
Accounts receivable	\$247.5	\$152.8
Notes receivable	131.0	121.4
Leases receivable:		
Financing leases, net of unearned income of \$19.5 and \$23.8, respectively	59.4	66.4
	\$437.9	\$340.6

Scheduled maturities, in millions of dollars, of the accounts, notes and leases receivable, due after one year for the next five years are \$186.0 in 1991, \$66.1 in 1992, \$47.0 in 1993, \$45.2 in 1994 and \$113.1 in 1995 and thereafter.

Note 6

Inventories and Contracts in Progress: Inventories and contracts in progress at December 31, 1989 consisted of inventories of \$4,866.3 million (\$5,286.4 million at December 31, 1988) and elevator and escalator contracts in progress of \$1,102.5 million (\$983.3 million at December 31, 1988).

The principal elements of cost included in inventories are materials, purchased components, direct labor and manufacturing overhead (engineering overhead in the case of engineering contracts). Tooling and other costs are an insignificant portion of inventories.

A substantial portion of the Corporation's inventories in its building systems and industrial products businesses is valued under the LIFO method. If these inventories had been valued at the lower of replacement value or cost under the first-in, first-out method, they would have been higher by \$127.7 million at December 31, 1989 (\$111.3 million at December 31, 1988).

The book basis of LIFO inventories exceeded the tax basis of such inventories by approximately \$58.5 million at December 31, 1989 and December 31, 1988, resulting from the assignment of fair value to inventories acquired in a business acquisition which has been accounted for as a purchase transaction.

The methods of accounting followed by the Corporation do not permit classification of inventories by categories of finished goods, work in process and raw materials. The Corporation's sales contracts in many cases are long-term contracts expected to be performed over periods exceeding twelve months. Approximately 62% (65% at December 31, 1988) of total inventories and contracts in progress has been acquired or manufactured under such long-term contracts. It is impracticable for the Corporation to determine the amounts of inventory scheduled for delivery under long-term contracts within the next twelve months.

Progress payments, secured by lien, on United States Government contracts, and billings on contracts in progress amounted to \$809.8 million (\$979.5 million at December 31, 1988) and \$1,247.8 million (\$1,088.8 million at December 31, 1988), respectively, at December 31, 1989.

Note 7

Consolidated Subsidiaries and Other Investments: Summarized financial data for the Corporation's finance subsidiaries consolidated in accordance with FAS 94, is presented below.

Finance Subsidiaries:

As of December 31, 1989, the Corporation's wholly-owned finance subsidiaries included UT Finance Corporation and its two consolidated subsidiaries. In 1988, the Corporation sold the stock of two subsidiaries, which conducted substantially all of the finance subsidiaries leasing activities. These sales resulted in the recognition

In 1988 of consolidated pretax gains of \$98.8 million including \$71.8 million recognized by the consolidated subsidiaries shown below.

Summary financial data for these subsidiaries is shown below:

In Millions of Dollars	1989	1988	1987
Revenues:			
Operating	\$ 81.6	\$ 87.7	\$123.9
Gain on sales of leasing subsidiaries	—	71.8	—
Total expenses	62.1	84.1	88.3
Net Income	\$ 19.5	\$ 75.4	\$ 35.6
Assets:			
Intercompany receivables, net	\$396.7	\$417.9	
Financing assets, net	336.2	292.0	
Other assets	12.6	15.7	
Total Assets	\$745.5	\$725.6	
Liabilities and Shareholder's Equity:			
Debt payable within one year	\$121.7	\$ 9.7	
Deferred income taxes	8.4	8.3	
Long-term debt	240.9	362.6	
Other liabilities	53.1	44.5	
Total Liabilities	\$424.1	\$425.1	
Shareholder's Equity	321.4	300.5	
Total Liabilities and Shareholder's Equity	\$745.5	\$725.6	

Since the sale of stock of the leasing subsidiaries, the finance company and its remaining subsidiaries are primarily engaged in financing products of the Corporation and its subsidiaries.

Other investments consist of the following:

In Millions of Dollars	1989	1988
Products under lease	\$169.7	\$131.9
Other companies	174.2	202.9
	\$343.9	\$334.8

Note 8

Deferred Charges: Included in deferred charges are costs in excess of the net assets of acquired companies (goodwill), net of amortization as follows:

In Millions of Dollars	1989	1988
Goodwill	\$ 834.2	\$ 397.9
Accumulated amortization	(166.2)	(137.0)
	\$ 668.0	\$ 260.9

The goodwill increased \$436.3 million principally as a result of completion of the acquisition of Sheller-Globe. See Note 3.

Note 9

Borrowings and Lines of Credit: The following summarizes the short-term borrowings and lines of credit, long-term debt and interest expense of the Corporation and all its consolidated subsidiaries.

Short-term borrowings:

In Millions of Dollars	1989	1988
Bank borrowings	\$ 149.0	\$267.7
Commercial paper	1,132.0	56.1
	\$1,281.0	\$323.8

At December 31, 1989, the Corporation had credit commitments by banks totaling \$1.05 billion under a Revolving Credit Agreement. The Revolving Credit Agreement provides for borrowings through January 1, 1993, at interest rates up to the prime rate and for a facility fee of 1/8% per year on the aggregate commitment. There were no borrowings under the Revolving Credit Agreement. At the end of 1989, the major portion of the bank borrowings shown in the table above were borrowings by non-U.S. subsidiaries.

Long-term debt:	1989 Debt		Amount (in millions)	
	Weighted Average Interest Rate	Maturity	1989	1988
Denominated in U.S. Dollars:				
Notes and other debt	9.17%	1991-2019	\$1,232.5	\$ 761.9
Sinking fund debt	8.82	1996-2016	434.1	487.4
Denominated in foreign currency:				
Notes and other debt	7.33	1991-2002	293.0	393.5
Total Long-term debt			\$1,959.6	\$1,642.8

Required payments on long-term debt for the next five years are \$292.6 million in 1990, \$152.7 million in 1991, \$407.0 million in 1992, \$271.6 million in 1993 and \$79.2 million in 1994.

Interest expense:

During 1989, the Corporation and its consolidated subsidiaries capitalized \$60.8 million (\$57.7 million in 1988 and \$43.4 million in 1987) of interest, to be depreciated over the lives of the related fixed assets.

Note 10

Taxes on Income: The provision for income taxes for each of the three years ended December 31 comprised the following:

In Millions of Dollars	1989	1988	1987
Current:			
United States:			
Federal	\$165.2	\$ 275.6	\$148.2
State	53.6	46.1	25.0
Foreign	247.8	233.1	152.9
	\$466.6	\$ 554.8	\$326.1
Deferred:			
United States:			
Federal	\$ 22.2	\$(101.9)	\$111.9
State	7.6	(8.3)	14.3
Foreign	1.4	15.5	5.7
	\$ 31.2	\$ (94.7)	\$131.9
Total	\$497.8	\$ 460.1	\$458.0

Deferred income taxes represent the tax effects of transactions which are reported in different periods for financial and tax reporting purposes. Changes in deferred U.S. federal, state and foreign income taxes shown in the income tax provisions include the income tax effects of:

In Millions of Dollars	1989	1988	1987
Use of completed-contract method for reporting taxable income	\$ 32.8	\$(69.1)	\$ 24.6
Tax depreciation and foreign capital allowances in excess of financial statement amounts	29.5	28.1	28.2
Capitalization of interest cost, less related depreciation	10.5	11.2	6.1
Adjustment of inventories and contract losses to tax basis	(103.0)	(74.8)	27.4
Expenditures (provisions) for warranty and correction of product deficiencies, tax deductible when paid	(22.6)	4.7	(9.1)
Insurance and employee benefits deductible on different bases for book and tax purposes	63.6	4.9	(5.5)
Customer allowances, tax deductible when paid or applied	14.0	(7.7)	(37.3)
Restructuring and employee severance provisions	1.6	6.0	115.6
Lease transactions, finance subsidiaries	.7	(1.2)	49.9
Alternative minimum tax	(15.0)	12.4	(12.4)
Other items, net	19.1	(9.2)	(55.6)
	\$ 31.2	\$(94.7)	\$131.9

The sources of income before income taxes, for each of the three years ended December 31, were:

In Millions of Dollars	1989	1988	1987
United States	\$ 633.9	\$ 667.1	\$ 648.1
Foreign	626.5	497.8	443.8
	\$1,260.4	\$1,164.9	\$1,091.9

Deferred income taxes generally have not been provided on undistributed earnings of international subsidiaries, amounting to \$851.4 million, included in consolidated retained earnings at December 31, 1989. A substantial portion of the undistributed earnings of the international subsidiaries has been reinvested and the Corporation believes that income taxes otherwise payable upon repatriation of earnings not reinvested would be largely offset by available foreign tax credits.

Differences between effective income tax rates and the statutory U.S. federal income tax rates, are as follows:

	1989	1988	1987
Statutory U.S. federal income tax rate	34.0%	34.0%	40.0%
State and local income taxes, net of federal tax benefit	3.2	2.1	2.2
Varying tax rates of consolidated subsidiaries (including Foreign Sales Corporation)	.2	3.7	(3.5)
Amortization of excess purchase cost and other purchase accounting adjustments, without tax effect	.6	.8	.5
Other	1.5	(1.1)	2.7
Effective income tax rates	39.5%	39.5%	41.9%

The statutory tax rate decrease to 34% in 1988, and from 46% to 40% in 1987, will give rise to adjustments in the deferred tax accounts under Financial Accounting Standard No. 96, "Accounting for Income Taxes," issued in December 1987 and required to be adopted no later than January 1, 1992. The Financial Accounting Standards Board is currently reviewing several provisions of the Standard and, therefore, the Corporation has not made a decision as to the date it will adopt FAS 96. If the Corporation had elected early

adoption of FAS 96, as currently written, as of January 1, 1989 and elected to restate prior periods' financial statements as permitted by the Standard, 1987 and 1988 earnings would be reduced by approximately \$180 million and \$30 million, respectively. There would have been no material impact on 1989 earnings. Of the 1987 charge to earnings, approximately \$155 million represents the cumulative effect of the adoption of the Standard. The provisions of FAS 96 as currently written will have potential for producing, under certain conditions, significant distortion in the Corporation's income tax provision and effective tax rate from year to year.

Note 11

Shareowners' Equity: At December 31, 1989, 14,582,957 shares of Common Stock were reserved for issuance under various employee incentive plans. See Note 12.

A Common Stock Purchase Right is attached to each share of Common Stock. Each Right entitles shareowners to buy, under certain circumstances, one newly issued share of the Corporation's Common Stock at an exercise price of \$150. The Rights will be exercisable only if a person or group acquires 20% or more of the Corporation's Common Stock or announces a tender or exchange offer for 30% or more of the Common Stock. If the Corporation is acquired in a merger or other business combination transaction, each Right will entitle its holder to purchase, for \$150, a number of the acquiring company's common shares having a market value of \$300. The Corporation will be entitled to redeem the Rights at 10 cents per Right prior to the earlier of the expiration of the Rights in January 1996 or the time that a 20% position has been acquired. Until the Rights become exercisable, they have no dilutive effect on the earnings of the Corporation. At December 31, 1989, 146,676,681 shares of Common Stock were reserved for issuance upon the exercise of these Rights.

The terms of the indentures relating to certain issues of long-term debt include provisions intended to restrict, under certain conditions, the availability of retained earnings for payment of dividends on the Common Stock. At December 31, 1989, all of the Corporation's retained earnings were free of such restrictions.

The \$4.50 Preferred Stock is redeemable at the option of the Corporation at \$105.00 per share plus accrued and unpaid dividends. At December 31, 1989, the aggregate liquidating preference of the \$4.50 Preferred Stock was \$.9 million.

Note 12

Employee Benefit Plans:

Employee Pension Benefits:

The Corporation and its domestic subsidiaries have a number of defined benefit pension plans covering substantially all U.S. employees. Plan benefits are generally based on years of service and the employee's compensation during the last several years of employment. The Corporation's funding policy is based on an actuarially determined cost method allowable under Internal Revenue Service regulations. The funds are invested either in various securities by trustees or in insurance annuity contracts. Certain foreign subsidiaries have defined benefit pension plans or severance indemnity plans covering their employees.

The Corporation accounts for the cost of its defined benefit plans in accordance with Financial Accounting Standard No. 87, "Employers' Accounting for Pensions" (FAS 87). The accounting requirements of FAS 87 were implemented in 1986 for defined benefit plans in the United States, Australia, Canada and the United Kingdom and in 1987 for substantially all other countries.

In addition to the defined benefit plans covering U.S. and foreign employees discussed above, the Corporation makes contributions to multiemployer plans (predominantly defined benefit plans) covering certain employees in some of its U.S. operations. Certain additional employees, primarily located in foreign countries, are covered by retirement arrangements which do not meet the reporting requirements of FAS 87.

Summarized below are the components of net periodic pension cost for defined benefit plans, net pension cost for multiemployer plans and other costs for pension and severance indemnity plans:

In Millions of Dollars	1989	1988	1987
Defined benefit plans:			
Service cost-benefits earned during the period	\$ 182.2	\$ 176.8	\$ 170.6
Interest cost on projected benefit obligation	422.0	374.4	360.6
Actual return on plan assets—investment losses/(gains)	(1,042.1)	158.3	(1,075.3)
Net amortization and deferral of actuarial (losses)/gains	443.6	(726.8)	553.1
Net periodic pension cost	\$ 5.7	\$ (17.3)	\$ 9.0
Net pension cost:			
Multiemployer plans	\$ 23.2	\$ 24.1	\$ 22.5
Other costs	\$ 13.0	\$ 13.1	\$ 10.8

Summarized below is the funded status of the defined benefit pension plans and the related amounts that are recognized in the consolidated balance sheet at December 31:

In Millions of Dollars	December 31, 1989		December 31, 1988	
	Assets Exceed Accumulated Benefits	Accumulated Benefits Exceed Assets	Assets Exceed Accumulated Benefits	Accumulated Benefits Exceed Assets
Actuarial present value of benefit obligations:				
Vested	\$4,130.1	\$ 256.7	\$3,416.0	\$ 302.7
Nonvested	298.9	17.7	279.8	31.8
Accumulated benefit obligation	4,429.0	274.4	3,695.8	334.5
Effect of projected future salary increases	1,014.0	67.4	868.6	108.0
Projected benefit obligation for services rendered to date	5,443.0	341.8	4,564.4	442.5
Plan assets available for benefits	6,478.3	121.1	5,429.5	215.4
Plan assets in excess of (less than) projected benefit obligation	1,035.3	(220.7)	865.1	(227.1)
Unrecognized net gain	(592.6)	(14.7)	(247.2)	(59.6)
Prior service cost not yet recognized in net periodic pension cost	133.9	14.0	39.4	12.0
Unrecognized net (asset) obligation at transition	(344.5)	94.6	(423.4)	141.7
Additional minimum liability recognized	—	(60.2)	—	—
Unrepaid pension cost (pension liability) included in other deferred charges (other long-term liabilities)	\$ 232.1	\$(187.0)	\$ 233.9	\$(133.0)

The pension funds are valued at September 30 of the respective years in the table above.

Major assumptions used in the accounting for the defined benefit pension plans are shown in the following table. As shown above, net periodic pension cost is determined using these factors as of the end of the prior year; whereas the funded status of the plans uses only the first two factors, as of the end of the current year.

	December 31,			
	1989	1988	1987	1986
Weighted-average discount rate	8.5%	8.5%	8.2%	8.2%
Rate of increase in future compensation	7.0%	7.0%	7.0%	7.0%
Expected long-term rate of return on assets	10.5%	10.5%	10.5%	10.0%

In 1989, 1988 and 1987 in accordance with FAS 88, the Corporation recognized net (losses)/gains of \$(6.3) million, \$13.1 million and \$17.9 million, respectively. These financial impacts resulted from the settlement of benefit obligations for retirees of

certain plans through the purchase of annuity contracts with insurance companies (1988 and 1987), from lump-sum cash payments to plan participants in exchange for their rights to receive specified pension benefits (1988 and 1987), from the reduction in the projected benefit obligations for certain employees affected by reductions in personnel at several operating units (1988) and from granting special termination benefits (1989).

Certain of the Corporation's international subsidiaries generally do not determine the actuarial value of accumulated benefits and the value of net assets on the basis shown above. For these plans, unfunded vested benefits as of December 31, 1989 and 1988 were \$.4 million and \$8.5 million, respectively. Liabilities under unfunded pension plans of certain international subsidiaries and for employee severance benefits, including those accruing to employees under foreign government regulations, are included in other long-term liabilities in the accompanying balance sheet.

Employee Health Care and Insurance Benefits:

In addition to providing pension benefits, the Corporation and a number of its subsidiaries provide certain health care and life insurance benefits for active and retired employees. Such benefits are provided through insurance companies whose premiums are based upon the benefits paid during the year. The Corporation recognizes the cost of providing those benefits by charging to expense the annual insurance premiums less any employee contributions, which in 1989 were approximately \$430 million (\$350 million in 1988 and \$320 million in 1987). The cost of providing those benefits for the 10,500 retirees is not separable from the cost of providing benefits for the 139,500 active employees.

Employee Incentive Plans:

On April 24, 1989, the Corporation's shareholders approved the Long-Term Incentive Plan (1989 Plan) reserving 6,000,000 shares of Common Stock for sale or award to officers and key employees. The 1989 Plan in effect replaces the 1979 Long-Term Incentive Plan (1979 Plan). The 1989 Plan also has the effect of amending

the terms of all grants and awards under the 1979 Plan that remain outstanding inasmuch as they shall be administered in accordance with the terms and provisions of the 1989 Plan.

The 1989 Plan authorized various types of market-based incentive and performance-based awards. The exercise price of an option, which will be set at the time of the grant, will not be less than the fair market value of the shares subject thereto on the date of grant. The maximum number of shares which may be utilized for awards granted during a given calendar year may not exceed 2% of the aggregate outstanding shares of Common Stock, Common Stock equivalents and Treasury shares as reported outstanding in the Annual Report on Form 10-K for the preceding fiscal year.

The 1979 Plan provided for the granting of Stock Appreciation Rights linked with stock options granted under either the 1979 Plan or the 1976 Plan. The exercise of either a Stock Appreciation Right or a stock option automatically cancels the connected option or right. The 1979 Plan also provided for the granting of Performance Units. All such Stock Appreciation Rights and Performance Units were either exercised or cancelled in 1989.

A summary of the transactions under all Plans for the three years ended December 31 follows:

	Stock Options		Stock Appreciation Rights		Other Incentive Awards
	Shares	Average Price	Rights	Average Price	Awards
Outstanding—December 31, 1986:	9,091,868	\$38.01	1,530,477	\$39.89	1,808,803
Granted	2,388,900	\$35.05	—	—	—
Exercised	(1,449,417)	\$29.70	(378,862)	\$36.45	—
Cancelled	(628,471)	\$37.80	(350,956)	\$38.14	(657,313)
Outstanding—December 31, 1987:	9,402,880	\$38.55	800,659	\$42.27	1,151,490
Granted	1,687,915	\$40.07	—	—	—
Exercised	(429,651)	\$25.68	—	—	—
Cancelled	(289,005)	\$38.97	(254,512)	\$37.69	(644,400)
Outstanding—December 31, 1988:	10,372,139	\$39.32	546,147	\$44.41	507,090
Granted	1,390,305	\$51.25	—	—	133,569
Exercised	(1,595,086)	\$35.33	(44,635)	\$46.85	—
Cancelled	(148,548)	\$42.52	(501,512)	\$44.19	(515,890)
Outstanding—December 31, 1989:	10,018,810	\$41.56	—	—	124,769

At December 31, 1989, stock options for 4,902,195 shares of Common Stock were exercisable at an average price of \$41.97 per share.

For 1989, \$40.5 million (\$40.7 million in 1988 and \$32.8 million in 1987) was charged to income with respect to employee incentive plans of the Corporation and certain of its subsidiaries, of which \$32.5 million (\$31.0 million in 1988 and \$31.3 million in 1987) was under the Corporation's principal incentive compensation plan, and the remainder was accrued under the 1989 Plan and other plans.

Employee Savings Plans:

In the second quarter of 1989, the Corporation established an Employee Stock Ownership Plan (ESOP) to serve as the vehicle for the Corporation's match of employee contributions within one of its existing savings plans. The Corporation's Board of Directors authorized 20,000,000 shares of preferred stock, par value \$1.00 per share, designated as Series A ESOP Convertible Preferred Stock, having a 7.38 percent dividend rate per annum. Each share of ESOP preferred stock is convertible into one share of common stock. On June 30, 1989, the ESOP Trust acquired 10,153,846 shares of this new series of preferred stock, at an acquisition price of \$65.00 per share. The ESOP financed the purchase of shares with interest bearing promissory notes aggregating \$660 million issued to the Corporation.

Shares of ESOP preferred stock are held by the ESOP Trustee with the number of shares allocated to each employee determined annually in accordance with a method approved by the Internal Revenue Service. To the extent that allocated shares are not sufficient to meet the matching requirement of the savings plan, the Corporation will contribute additional ESOP preferred stock, common stock or cash. At December 31, 1989 approximately 180,000 additional ESOP preferred stock shares, or its equivalent, would need to be contributed to meet the savings plan matching requirement.

Shares allocated to employees generally may not be withdrawn until the employee's termination, disability, retirement or death. Upon withdrawal, shares of ESOP preferred stock must be converted into one share of the Corporation's common stock or, if the value of the common stock is less than the original acquisition price of \$65.00, the ESOP Trustee may require the Corporation to repurchase the ESOP preferred stock for the guaranteed value of \$65.00. Because of the guaranteed value, the ESOP preferred stock is classified outside of permanent equity.

The ESOP is in the process of arranging permanent financing which will be used to repay the promissory notes to the Corporation. The ESOP's debt will be guaranteed by the Corporation and,

accordingly will be recorded in the long-term debt section of the Corporation's consolidated balance sheet with a corresponding offset to the ESOP preferred stock. The Corporation shall contribute sufficient funds each year which, when combined with quarterly dividends on the ESOP preferred stock, will be used to meet the ESOP's debt service requirements. As of December 31, 1989 the ESOP has incurred interest expense of \$32.3 million on its outstanding notes payable.

Dividends on ESOP preferred stock are deductible for U.S. income tax purposes. The tax benefit to the Corporation resulting from such dividends has been applied as a reduction of the preferred stock dividends in the financial statements.

The ESOP preferred stock is redeemable, in whole or in part, at the option of the Corporation at a redemption price of \$69.80 per share plus accrued and unpaid dividends during each twelve month period beginning June 10, 1989, and decreasing annually until reaching \$65.00 per share, beginning June 10, 1999. At December 31, 1989, the aggregate redemption value of the ESOP preferred stock was \$708.7 million.

Contributions to the ESOP together with the value of additional ESOP preferred stock, common stock or cash necessary to satisfy the matching requirement are charged to expense. The Corporation and a number of its subsidiaries have additional savings plans in which a portion of employee contributions is matched in cash by the employer. The amount expensed related to all savings plans totaled \$63.5 million in 1989 (\$63.6 million in 1988 and \$60.6 million in 1987).

In conjunction with the establishment of the ESOP, the Corporation repurchased 10,400,000 shares of its common stock at an average cost of \$53.99 per share to provide for the conversion option of the preferred stock.

Note 13

Commitments and Contingent Liabilities: The Corporation and its consolidated subsidiaries occupy space and use certain equipment under lease arrangements. Rent expense in 1989, 1988 and 1987 under such arrangements totaled \$343.1 million, \$341.2 million and \$320.5 million, respectively. The Corporation is not a lessee under any capital leases of significance. Rental commitments at December 31, 1989 under long-term noncancelable operating leases were as follows:

In Millions of Dollars	Land, Buildings and Office Space	Machinery, Tools and Equipment
1990	\$118.6	\$103.0
1991	102.9	75.9
1992	82.7	48.8
1993	61.8	17.9
1994	48.7	5.8
After 1994	195.1	4.0
	\$609.8	\$255.4

At December 31, 1989, the Corporation had commitments to finance or arrange financing for approximately \$3 billion of commercial aircraft. The total may be required to be disbursed as follows: \$600 million in 1990, \$500 million in 1991, \$250 million in 1992, \$850 million in 1994 and \$800 million in 1996 and later years.

At December 31, 1989, the Corporation had approximately \$380 million of guarantees outstanding related to various customer financing arrangements, principally commercial aircraft engine customers. These guarantees may extend for fifteen years or more and may have been used by the customers to obtain more favorable financing terms than would otherwise be available. Where applicable, the estimated fair market values at December 31, 1989 of the aircraft underlying these guarantees equaled or exceeded the related guarantee amount.

Like many defense contractors, the Corporation has received allegations from the U. S. Government that some contract prices should be reduced because cost or pricing data submitted in negotiation of the contract prices may not have been current, accurate and complete. The Corporation has made voluntary refunds in those cases it believes appropriate, has settled some allegations, and does not believe that any further price reductions that may be required will have a material effect upon its earnings or financial condition.

In addition, the Corporation has commitments and contingent liabilities related to legal proceedings, environmental and other matters arising out of the normal course of business. Management does not expect that amounts, if any, which may be required to be paid by reason of commitments, guarantees, legal proceedings or other contingencies will be of material importance to the financial condition or earnings of the Corporation.

Note 14

Business Segment Financial Data: Business segment information for the three years ended December 31, 1989, required by Financial Accounting Standard No. 14, appears in the Consolidated Summary of Business Segment Financial Data on pages 51 through 53.

Consolidated Summary of Business Segment Financial Data

United Technologies Corporation

Industry Segments

In Millions of Dollars

Years Ended December 31,

1989

1988

1987

Revenues

Power	\$ 6,991.1	\$ 6,346.7	\$ 5,739.6
Flight Systems	3,592.1	3,505.8	3,246.0
Building Systems	7,260.7	6,523.3	5,734.3
Industrial Products for the Automotive and Other Industries	1,931.6	1,965.8	2,713.9
Other	217.1	217.4	252.0
Corporate items and eliminations	(236.1)	(41.1)	(249.6)
Consolidated revenue	<u>\$19,756.5</u>	<u>\$18,517.9</u>	<u>\$17,436.2</u>

Operating Profit

Power	\$ 946.5	\$ 685.2	\$ 687.9
Flight Systems	55.7	(15.4)	97.0
Building Systems	481.4	409.0	396.6
Industrial Products for the Automotive and Other Industries	157.8	216.7	236.1
Other	(54.5)	(47.5)	(49.1)
Eliminations	3.1	(.7)	1.0
Operating profit	<u>1,590.0</u>	<u>1,247.3</u>	<u>1,369.5</u>
Financing revenues and other income, less other deductions	49.3	260.3	75.7
Interest expense	(346.5)	(312.1)	(331.7)
General corporate expenses	(32.4)	(30.6)	(21.6)
Consolidated income before income taxes	<u>\$ 1,260.4</u>	<u>\$ 1,164.9</u>	<u>\$ 1,091.9</u>

Identifiable Assets

Power	\$ 4,766.8	\$ 4,140.9	\$ 4,005.7
Flight Systems	2,220.0	2,295.8	1,926.4
Building Systems	3,642.6	3,496.5	3,056.9
Industrial Products for the Automotive and Other Industries	2,005.5	907.3	1,344.1
General corporate assets and other	1,963.3	1,907.8	2,540.4
Consolidated assets	<u>\$14,598.2</u>	<u>\$12,748.3</u>	<u>\$12,873.5</u>

Capital Expenditures

Power	\$ 422.5	\$ 328.1	\$ 404.2
Flight Systems	148.0	158.8	115.0
Building Systems	243.5	230.1	176.0
Industrial Products for the Automotive and Other Industries	138.6	115.1	101.2
General corporate assets and other	70.7	43.2	42.6
Consolidated additions to fixed assets	<u>\$ 1,023.3</u>	<u>\$ 875.3</u>	<u>\$ 839.0</u>

The 1988 operating profit amounts above include the restructuring and employee severance charges (see Note 2). The operating profits before such charges were Power — \$713.8 million and Flight Systems — \$104.8 million.

Consolidated Summary of Business Segment Financial Data continued

United Technologies Corporation

Geographic Areas

In Millions of Dollars	Years Ended December 31,		
	1989	1988	1987
Revenues			
United States operations	\$14,403.2	\$13,451.4	\$13,072.7
International operations:			
Europe	3,101.0	2,753.0	2,677.9
Other	3,405.6	2,714.7	2,366.6
Corporate items and eliminations	(1,153.3)	(401.2)	(681.0)
Consolidated revenue	<u>\$19,756.5</u>	<u>\$18,517.9</u>	<u>\$17,436.2</u>

Operating Profit

United States operations	\$ 880.6	\$ 658.8	\$ 892.0
International operations:			
Europe	360.6	298.5	246.8
Other	391.2	316.3	257.5
Eliminations	(42.4)	(26.3)	(26.8)
Operating profit	1,590.0	1,247.3	1,369.5
Financing revenues and other income, less other deductions	49.3	260.3	75.7
Interest expense	(346.5)	(312.1)	(331.7)
General corporate expenses	(32.4)	(30.6)	(21.6)
Consolidated income before income taxes	<u>\$ 1,260.4</u>	<u>\$ 1,164.9</u>	<u>\$ 1,091.9</u>

Identifiable Assets

United States operations	\$ 9,255.7	\$ 7,755.7	\$ 7,438.7
International operations:			
Europe	1,925.2	1,679.3	1,871.0
Other	1,975.8	1,852.1	1,571.3
General corporate assets and other	1,441.5	1,461.2	1,992.5
Consolidated assets	<u>\$14,598.2</u>	<u>\$12,748.3</u>	<u>\$12,873.5</u>

See accompanying Notes to Consolidated Summary of Business Segment Financial Data.

The 1988 operating profit amounts above include the restructuring and employee severance charges which only impacted United States operations (see Note 2).

Notes to Consolidated Summary of Business Segment Financial Data

(A) The Corporation and its consolidated subsidiaries design, develop, manufacture and sell high-technology products, classified in four principal industry segments or lines of business in accordance with Financial Accounting Standard No. 14.

Power products are principally aircraft engines and substantial spare parts. Energy process equipment (through May 1987, when the business was sold) and modified aircraft engines and related equipment for electrical power generation and other applications are also included.

Flight Systems products include helicopters and spare parts, propellers, rocket motors, and fuel control, environmental, radar, cockpit and integrated display and other airborne and space systems.

Building Systems products include air conditioning equipment, elevators and escalators, substantial service, maintenance and spare parts.

Industrial Products for the Automotive and Other Industries include electrical wiring systems, electromechanical and hydraulic devices, fuel injection systems (through April 1987, when the business was sold), electric motors, car and truck interior trim components, and other products for the automotive industry; and controls and control systems for the appliance and related industries. Also included is the Corporation's wire and cable business, including magnet wire and winding machinery for the electric motor, transformer and electromagnetic equipment industries, and a variety of wire and cable products (through February 1988, when the business was sold).

Activities classified as "Other" consist of a variety of business and developmental activities, including the design and manufacture of naval radar, military command and control and computer systems, and microelectronics circuits.

Leasing activities conducted by the Corporation's finance subsidiaries, which have been consolidated in accordance with FAS 94 (see Note 7), are not considered an industry segment or line of business. All finance subsidiaries' activities are conducted and located in the United States.

(B) Revenue by industry segment, and geographic area, includes intersegment sales and transfers between geographic areas. Generally, such sales and transfers are made at prices approximating those which the selling or transferring entity is able to obtain on sales of similar products to unaffiliated customers.

Revenues include sales under prime contracts and subcontracts to the U.S. Government, for the most part Power and Flight Systems products, as follows:

In Millions of Dollars	1989	1988	1987
Power	\$2,338.6	\$2,163.5	\$2,039.4
Flight Systems	\$2,160.1	\$2,253.8	\$2,367.4

Revenues from United States operations include export sales of \$3,307.4 million in 1989, \$2,848.1 million in 1988 and \$2,071.0 million in 1987. Export sales to Europe were \$786.1 million, \$568.0 million and \$319.9 million of the 1989, 1988 and 1987 amounts, respectively. Export sales include direct sales to commercial customers outside the United States and sales to the U.S. Government, commercial and affiliated customers which are known to be for resale to customers outside the United States.

(C) Identifiable assets are those which are specifically identified with the industry segments and geographic areas in which operations are conducted. General corporate assets consist principally of cash and short-term cash investments and investments in other companies.

Depreciation charges are as follows:

In Millions of Dollars	1989	1988	1987
Power	\$266.3	\$240.9	\$221.2
Flight Systems	\$106.8	\$ 97.1	\$ 90.8
Building Systems	\$128.4	\$112.6	\$101.4
Industrial Products	\$ 51.5	\$ 48.7	\$ 64.6

(D) Eliminations made in reconciling industry and geographic area data with the related consolidated amounts include intersegment sales and transfers between geographic areas, unrealized profits in inventory and similar items.

(E) The Summary of Business Segment Financial Data should be read in conjunction with the other financial statements of the Corporation and notes thereto appearing elsewhere in this Annual Report.

Selected Quarterly Financial Data

United Technologies Corporation

In Millions of Dollars (except per share amounts)	Quarter Ended				For the Year
	March 31	June 30	September 30	December 31	
1989					
Sales	\$4,415.4	\$5,237.5	\$4,709.9	\$5,169.3	\$19,532.1
Financing revenues and other income, less other deductions	49.4	36.3	43.7	95.0	224.4
Gross profit	1,198.7	1,356.8	1,266.2	1,328.2	5,149.9
Net income	123.7	197.3	196.7	184.4	702.1
Earnings per share—primary	.95	1.50	1.46	1.43	5.34
—fully diluted	.95	1.50	1.39	1.36	5.20
1988					
Sales	\$4,109.3	\$4,360.1	\$4,356.0	\$5,174.7	\$18,000.1
Financing revenues and other income, less other deductions	215.7	94.9	110.4	96.8	517.8
Gross profit	969.2	1,198.4	1,144.0	1,202.5	4,514.1
Net income	122.2	196.2	190.1	150.6	659.1
Earnings per share	.94	1.50	1.45	1.16	5.05

Notes:

In the first quarter of 1988, the Corporation's Board of Directors approved restructuring actions at certain operating entities resulting in charges to cost of goods and services sold aggregating \$148.8 million. Also in the first quarter of 1988, the Corporation sold its Essex subsidiary and certain leasing subsidiaries, resulting in pretax gains of \$160.6 million.

During the second quarter of 1988, the Corporation sold its share of a semiconductor joint venture, resulting in a pretax gain of \$41.4 million.

In the third quarter of 1988, the Corporation sold additional leasing subsidiaries, resulting in a pretax gain of \$33.3 million.

Directors

Board of Directors

Howard H. Baker, Jr.
Partner,
Baker, Worthington, Crossley,
Stansberry & Woolf
(Attorneys)

Antonia Handler Chayes
Chairman,
Endispute Incorporated
(Legal Consultation and
Alternative Dispute Resolution)

Robert F. Daniell
Chairman and
Chief Executive Officer

Robert F. Dee
Retired Chairman of the Board,
SmithKline Beckman Corporation
(Pharmaceuticals)

Charles W. Duncan, Jr.
Chairman of the Board,
Duncan, Cook & Co.
(Private Investments)

T. Mitchell Ford
Retired Chairman of the Board and
Chief Executive Officer,
Emhart Corporation
(Diversified Manufacturer)
Of Counsel, Shipman & Goodwin
(Attorneys)

Pehr G. Gyllenhammar
Chairman and
Chief Executive Officer,
AB Volvo
(Automotive, Aerospace,
Food and Finance)

Gerald D. Hines
Owner, Gerald D. Hines Interests
(Real Estate Development)

Edward W. Large
Executive Vice President,
Special Advisor to the Chairman

Robert H. Malott
Chairman of the Board and Chief
Executive Officer,
FMC Corporation
(Machinery and Chemicals)

John S. Reed
Chairman and
Chief Executive Officer,
Citicorp and Citibank, N.A.
(Financial Institution)

Richard S. Smith
Retired Vice Chairman
and Director,
National Intergroup, Inc.
(Metal Products)

Jacqueline G. Wexler
President, National Conference
of Christians and Jews

Permanent Committees

Executive Committee

Robert F. Daniell, Chairman
T. Mitchell Ford
Edward W. Large
Robert H. Malott
Richard S. Smith

Audit Review Committee

Richard S. Smith, Chairman
Antonia Handler Chayes
Pehr G. Gyllenhammar
Robert H. Malott
Jacqueline G. Wexler

Committee on Compensation and Executive Development

T. Mitchell Ford, Chairman
Robert F. Dee
John S. Reed
Jacqueline G. Wexler

Nominating Committee

Charles W. Duncan, Jr.,
Chairman
Robert F. Daniell
Robert F. Dee
T. Mitchell Ford
John S. Reed

Pension Committee

Robert H. Malott, Chairman
Robert F. Dee
John S. Reed
Richard S. Smith

Public Issues Review Committee

Jacqueline G. Wexler, Chairman
Antonia Handler Chayes
Charles W. Duncan, Jr.
Pehr G. Gyllenhammar

Finance Committee

John S. Reed, Chairman
Robert F. Daniell
Charles W. Duncan, Jr.
Pehr G. Gyllenhammar

Leadership

Selwyn D. Berson
Group Vice President and President,
Commercial Engine Business,
Pratt & Whitney Group

Norman R. Bodine
President, Automotive Products
Division, UT Automotive

William R. Brown
President, Latin
American Operations, Carrier

Eugene Buckley
President, Sikorsky Aircraft

Franklyn A. Caine
Senior Vice President, Human
Resources and Organization

L. David Caplan
President and
Chief Executive Officer,
Pratt & Whitney Canada Inc.

Mark S. Coran
Vice President, Controller

Robert F. Daniell
Chairman and
Chief Executive Officer

George A.L. David
Executive Vice President and
President, Commercial/Industrial

Frederick C. Flynn, Jr.
Vice President, Treasurer

Pierre J. Fougeron
President, European and
Transcontinental Operations,
Otis

F. Mark Granato
Vice President, Communications

John M. Hammitt
Vice President, Information Systems

Frederick D. Hay
President, Engineered Systems
Division, UT Automotive

Robert J. Hermann
Vice President,
Science and Technology

Edward M. Irving
Senior Vice President,
Industrial Group-
President, UT Automotive

Albert J. Kelley
Senior Vice President,
Strategic Planning

David M. Kelly
President, North American
Operations, Carrier

Karl J. Krapek
President and
Chief Operating Officer,
Otis

Jeffrey L. Kushner
Vice President

Edward W. Large
Executive Vice President,
Special Advisor to the Chairman

Martin R. Lewis, Jr.
President, Control Systems

Frank W. McAbee, Jr.
Vice President, Business Practices

Brian D. McMahon
President, European
Transcontinental
Operations, Carrier

William C. Missimer, Jr.
Group Vice President and President,
Government Engine Business,
Pratt & Whitney Group

Daniel R. Nuzzo
President, Norden Systems

James G. O'Connor
Executive Vice President,
Pratt & Whitney Group

William F. Paul
Senior Vice President,
Washington Office

Nicholas T. Pinchuk
President, Asia
Pacific Operations,
Carrier

Lawrence R. Purtell
Secretary and Associate General
Counsel

John A. Rolls
Executive Vice President and
Chief Financial Officer

George J. Sanford, Jr.
Vice President, Corporate
Purchasing

Jonathan M. Schofield
President, United Technologies
International Corporation

Vernon K. Stait
President, Pacific Area
Operations, Otis

Terry D. Stinson
President, Hamilton Standard

Karl M. Thomas
Group Vice President,
Operations,
Pratt & Whitney Group

William H. Trachsel
Vice President and
Deputy General Counsel

Jean-Pierre van Rooy
President, North American
Operations, Otis

Arthur E. Wegner
Executive Vice President and
President, Aerospace/Defense,
President, Pratt & Whitney Group

William A. Wilson
President and Chief Executive
Officer, Carrier

Irving B. Yoskowitz
Senior Vice President and
General Counsel

Shareowner Information

Corporate Office

United Technologies Building
Hartford, Connecticut 06101
Telephone (203) 728-7000

This annual report is sent to shareowners in advance of the proxy statement for the annual meeting to be held at 11 a.m., April 23, 1990, in Hartford, Connecticut. The proxy statement will be sent to holders of Common Stock and \$4.50 Preferred Stock on or about March 14, 1990, at which time proxies for the meeting will be requested.

Stock Listing

Common

New York, London, Paris,
Frankfurt, Geneva, Lausanne,
Basel, Zurich, Brussels and
Amsterdam Stock Exchanges

Ticker Symbol

Common UTX

Transfer Agent

For the Common Stock and
for the \$4.50 Preferred Stock:

First Chicago
Trust Company of New York
30 West Broadway
New York, New York 10007

Registrar

For the Common Stock:

First Chicago
Trust Company of New York
30 West Broadway
New York, New York 10007

Registrar

For the Preferred Stock:

Manufacturers Hanover
Trust Company
450 West 33rd Street
New York, New York 10015

Dividends

Dividends are usually declared the first month of each calendar quarter and are usually paid on the 10th day of March, June, September and December.

The dividend disbursing agent for the Common Stock and the \$4.50 Preferred Stock is:

First Chicago
Trust Company of New York
Stock Transfer Department
30 West Broadway
New York, New York 10007
Dividend and Transfer inquiries:
(212) 791-6422

Additional Information

Shareowners may obtain a copy of the 1989 United Technologies 10-K report filed with the Securities and Exchange Commission by writing to Lawrence R. Purtell, Secretary, United Technologies Corporation, United Technologies Building, Hartford, Connecticut 06101.

Shareowners may obtain a list of United Technologies' charitable contributions for 1989 by writing to the above address.

For additional information about United Technologies, please contact the Investor Relations Department at the above Corporate Office address.

RCRA Part B Permit Application
United Technologies
Pratt & Whitney
CTD 990672081

Page 121 of 125
November 12, 1990

APPENDIX H-1
CLOSURE PLAN FOR THE BURN-ZOL
HAZARDOUS WASTE INCINERATOR



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION I

J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

September 11, 1989

APPROVAL

Mr. John G. Whitehead, Plant Manager
UTC Pratt & Whitney Aircraft
400 Main Street
East Hartford, Connecticut 06108

RE: Approval of partial closure plan for incinerator at Pratt & Whitney Aircraft, East Hartford, Connecticut CTD 990672081

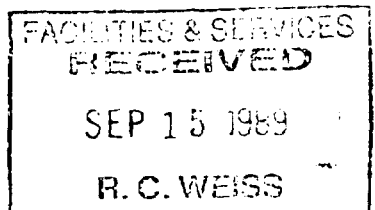
Dear Mr. Whitehead:

The partial closure plan dated May 2, 1988 as amended July 7, 1989 and August 17, 1989 that was prepared for Pratt & Whitney Aircraft, 400 Main Street, East Hartford, Connecticut has been reviewed by the Connecticut Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA) Region I.

The DEP and EPA have determined that these plans comply with the closure requirements pursuant to Section 22a-449(c)-29 of the regulations of Connecticut State Agencies and with Title 40 Part 265 Subparts G and O of the Code of Federal Regulations. Both agencies hereby approve the plan as submitted provided the following conditions are met:

1. Pratt and Whitney Aircraft shall contact DEP/EPA for review of the following closure plan events at least 14 days prior to their implementation:
 - a. Prior to sampling for hazardous constituents.
2. The background decontamination standard must be the lowest value obtained of the two samples taken.

All work shall be subject to the review of the DEP and the EPA. They shall decide all questions as to interpretations of approved plans and specifications.




Mr. John C. Whitehead
UTC Pratt & Whitney Aircraft
Approval


September 11, 1989

The Regional Administrator of the EPA and the Commissioner of the DEP may authorize changes to the approved closure plan upon written request pursuant to 40 CFR 265.112(c).

This approval does not relieve the facility of the obligation to obtain any other authorization as may be required by other provisions of the Connecticut General Statutes, Regulations of Connecticut State Agencies, Code of Federal Regulations, or Federal Statutes.

Sincerely,


Stephen W. Hitchcock, Director
Hazardous Material Management Unit
Connecticut Department of
Environmental Protection


Merrill S. Hohman, Director
Waste Management Division
Region I
U. S. Environmental
Protection Agency



400 Main Street
East Hartford, Connecticut 06108

August 17, 1989

Mr. George Dews
Senior Sanitary Engineer
Hazardous Waste Management Section
Department of Environmental Protection
165 Capitol Avenue
Hartford, CT 06106

Mr. Stephen Yee
Environmental Engineer
Waste Management Division
US EPA
90 Canal Street - 3rd Floor
Boston, MA 02114

Re: Letter Addendum to the Burn-Zol Hazardous Waste
Incinerator Closure Plan
UTC - Pratt & Whitney East Hartford, CT
EPA ID # CT D990672081

Dear Sirs:

Pratt & Whitney is pleased to submit a letter addendum to the latest submittal of the Burn-Zol Hazardous Waste Closure Plan. This addendum was requested in a joint comment letter from EPA/DEP dated August 1, 1989. We have responded to each agency comment in sequence as presented below:

COMMENT 1

The proposed analytical parameter list for environmental sampling is presented as Table 2 in Section 11.0 of the closure plan. We believe that this list represents all of the Appendix VIII constituents potentially present in either the wax/solvent or the cyanide waste streams. It should be emphasized that these two waste streams were the only wastes incinerated during the final burns.

The parameter list was developed based on a review of waste stream analytical data (Appendix C of the closure plan), and the applicable process solutions that, upon disposal, constitute the subject waste streams. A discussion of each waste stream is presented below.

Wax/Solvent Mixture

The wax/solvent mixture waste stream is generated during the cleaning of machine parts in which selected areas are covered by a

film of wax. The wax is removed in a solvent dewaxing operation and the resulting wax/solvent mixture is periodically removed to a solvent reclamation area. Material that cannot be reclaimed is collected and stored as a hazardous waste at Pratt & Whitney's Concentrated Waste Treatment Plant (CWTP).

The two solvents utilized during the dewaxing operation are tetrachloroethylene and 1,1,1-trichloroethane. A review of available material safety data sheets (MSDSs) for these solvents and the wax resulted in identifying no Appendix VIII constituents beyond the analytical parameter proposed in the closure plan. Copies of the applicable MSDSs are presented as Attachment A.

Cyanide Solution

The cyanide solution waste stream is generated from spent process solutions relating to electroplating operations. Representative Pratt & Whitney process solutions have been identified and the applicable MSDSs for the solutions have been reviewed. Copies of these MSDSs are presented as Attachment B. No Appendix VIII constituents beyond the proposed analytical parameter list have been identified.

COMMENT 2

Analytical results from ceiling wipe sampling will function as the quantitative criteria for the determination that non-porous ceiling surfaces cleaned by hydroblasting are decontaminated properly. The approach, sample methodology and data evaluation are described in detail as follows:

Approach

As specified in Section 2.0 of the closure plan, hydroblasting of the ceiling will be the method employed to decontaminate the ceiling in the building formerly housing a portion of the incinerator train. Hydroblasting will proceed to the plastic sheeting barrier which separates the incinerator closure activities from the active wax/solvent storage area.

The ceiling area included during closure activities totals approximately 1100 square feet. An additional 550 square feet of ceiling area is present outside of the decontamination area. This area is considered separate from all closure activities and representative of ambient background conditions within the building.

A total of six discrete sample locations are proposed based on a systematic sampling grid presented as Attachment C. Four of the sample locations are present within the hydroblasting area. Analytical results for these samples will be used to evaluate the decontamination effort. Two sample locations are present outside of the hydroblasting area. Analytical results for these samples will represent background conditions removed from the hydroblasting; therefore, these results will function as the closure performance standard for non-porous surface decontamination.

Each sample will be analyzed for the compounds presented in Table 2 of Section 7.0 of the closure plan. Quality assurance/quality control measures proposed for wipe sampling activities will include the analysis of field blanks and trip blanks.

Sample Methodology

A matrix and constituent specific sample methodology has been developed for ceiling wipe sampling activities. This methodology has been formulated following the review of existing wipe sampling methodologies and the proposed analytical parameter list in the closure plan.

A total of three 100 cm² areas will be included at each sample location. The three areas have been segregated based on the analytical parameter list for volatile organic compounds, cyanide and metal compounds. The areas to be included during sample collection will be defined by a 100 cm² template. Magnets will be used to secure the template to the ceiling surface.

The wipe medium will consist of 0.8 micron glass fiber filters supplied by the laboratory. Clean, laboratory supplied, disposable latex gloves will be used at each sample location. The wipe extraction solvent will be unique for each template at a given sample location. A description of the sequence of sampling is presented below.

- The wipe area designated for volatile organic compounds will be sampled first. The 100 cm² template will be positioned over this area and a total of three wipes will be conducted. Two of the wipes will utilize an extraction solvent and the third wipe will be dry. The extraction solvent will be laboratory supplied methanol furnished in a wide mouth glass jar. Wipe #1 will be dipped into the methanol using a dedicated pair of stainless steel tweezers. The area within

the template is wiped and the wipe is immediately placed into a wide mouthed sample jar with a teflon lined cap. The cap will be temporarily secured to the sample jar to limit exposure to the atmosphere. Wipe #2 will be performed exactly as the first. Wipe #3 is used dry to absorb any methanol left within the template sample area. This final wipe will also be immediately transferred to the same jar as wipes #1 & #2.

The wipe area designated for cyanide will be sampled second. A new template will be positioned adjacent to the volatile organic compound sample area. The procedure for cyanide sampling is the same as for volatile organic compounds; however, the extraction solvent during wet wipe sampling will consist of a caustic solution comprised of 3.0 milliliters of 20% caustic solution to two liters of laboratory supplied distilled water.

The wipe area designated for metals will be sampled last. A new template will be positioned adjacent to the cyanide and volatile organic compound areas. The procedure for metals sampling is the same as for volatile organic compounds; however, the extraction solvent used during wet wipe sampling will consist of an acidic solution comprised of 8.0 milliliters of 1-1 nitric acid to 2 liters of laboratory supplied distilled water. In addition, plastic tweezers will be used to dip the wipe into the extraction solvent.

The field quality assurance/quality control program will consist of a field blank and a trip blank. The field blank will be collected in the same manner as field samples; however, the wipes will simply be exposed to the atmosphere and immediately transferred to the sample jars. The trip blank will consist of laboratory supplied dionized water in a 40 milliliter glass vial with a teflon lined cap. This sample will accompany the sample jars to and from the laboratory.

Immediately following sample collection, each sample will be labelled and placed in an iced cooler. The samples will be transported under full chain-of-custody to a State of Connecticut approved laboratory.

Data Evaluation

Analytical results for wipe samples will be reported as the mass of constituent tested per unit sample area (100 cm^2). The internal laboratory QA/QC program will consist of customary laboratory precision controls and matrix spike sample analysis. The matrix spike sample will consist of one wipe sample set in which each wipe fraction is spiked with a known concentration of a specified contaminant. The sample will then be analyzed to determine the percent recovery of the known contaminant.

Initially, sample data will be evaluated through data validation procedures. Data points that are not supported by the QA/QC procedures will be referred to the sampling team and/or laboratory for appropriate corrective actions.

Upon completion of data validation, the results will be compared to background data points and to the established laboratory method detection limits. Decontamination of the ceiling will be deemed complete if analytical results in the hydroblasting area fall below the method detection limits (non-detectable). If any parameter is quantified above the method detection limit but below the background sample concentration for that parameter then decontamination is deemed complete. If any parameter is quantified above the method detection limit and above the background sample concentration for that parameter then decontamination is deemed incomplete and must continue until subsequent sampling results meet the background sample concentrations.

COMMENT 3

Concrete chip sampling procedures are referenced in Section 10.0 of the closure plan (page 13). The fifth paragraph, fourth sentence of this section will be changed to read "A chisel will be used to dislodge the concrete chips".

COMMENT 4

This observation is correct. The word "equipment" will be added to the 3rd paragraph, 4th sentence of Section 3.0.

COMMENT 5

Review of available manufacturer's specifications indicates the casing construction of the incinerator combustion chamber is double walled with an inner steel wall and an outer stainless steel wall. The interstitial space between the two walls totals approximately three inches. This air space is isolated to form a forced air distribution jacket for external skin cooling.

COMMENT 6

As stated in Section 7.0 of the closure plan, all rinsates generated during incinerator closure activities will be collected and treated as a hazardous waste at Pratt & Whitney's Concentrated Waste Treatment Plant. An expanded discussion of our proposed rinsate handling is presented below.

All rinsate generated during incinerator closure activities will be collected in portable hazardous waste storage containers provided by the CWTP. Accumulated liquids will then be transferred to stationary storage containers currently operated by the CWTP. The rinsates from the cyanide waste feed line decontamination and hydroblasting operations will be stored together. The accumulated liquid will ultimately be vendored off to a RCRA permitted facility for final treatment. The rinsate generated from the blended oil waste feed line decontamination will be stored separately. This liquid will ultimately be vendored off to a RCRA permitted facility for final disposal (incineration).

The CWTP will only function as the interim storage facility prior to vendor disposal. No rinsates will be disposed of at the CWTP. In addition, no rinsates will be discharged under the CWTP's NPDES permit.

COMMENT 7

Yes, a secure landfill disposal facility refers to a RCRA permitted disposal facility.

COMMENT 8

The current layout of incinerator train components is depicted in the closure plan as Appendix B, Figure 3. The components can be segregated into three distinct areas of which two areas are outside of the building. For incinerator train components inside the building, a safe perimeter will be established at the building entrance. For incinerator train components outside of the building, the safe perimeter will be a minimum of fifteen feet on all sides of the equipment. This perimeter will be marked using plastic barricade tape.

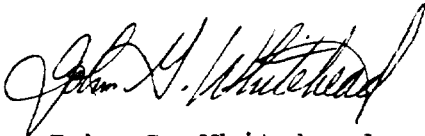
The final Site Health and Safety Plan will address this issue and provisions will be incorporated to account for incinerator train components located outside of the building.

August 17, 1989
Burn-Zol Addendum
- Page 7 -

We are eager to begin closure activities promptly upon final closure plan approval. In anticipation of this approval, we are currently identifying the qualified contractors necessary to perform these specialized closure activities.

If you have any questions or comments regarding the enclosed, please contact Scott Singer at (203) 565-2016.

Sincerely,

A handwritten signature in cursive script, appearing to read "John G. Whitehead".

John G. Whitehead
Plant Manager

SLS/JGW/bab

s-s3o

BURN-ZOL LETTER ADDENDUM
ATTACHMENTS

August 17, 1989

ATTACHMENT A

MATERIAL SAFETY DATA SHEETS

WAX/SOLVENT MIXTURE

Material Safety Data Sheet

MSD 8208.22

DETREX CORPORATION P.O. Box 5111, Southfield, MI 48033-5111

RECEIVED

JAN 07 1988

9015

rev. 11/85



Approved by U.S. Dept. of Labor as "Essentially similar" to Form OSHA-20

Date: November, 1985	Edition: Second
Chemical Name and Synonyms: Perchloroethylene; tetrachloroethylene CAS No.: 127-18-4	Trade Name and Synonyms: DETREX PERK GOLD SHIELD PERK Perchlor., Perchloroethylene
Chemical Family: Halogenated Hydrocarbons	Formula: $\text{CCl}_2=\text{CCl}_2$
DOT Shipping Name: Tetrachloroethylene	DOT Hazard Class: ORM-A UN1897

SECTION 1 • PHYSICAL DATA

Boiling Point @ 760 mm Hg: 121°C 250°F	Vapor Density (Air=1): 5.83	Specific Gravity ($\text{H}_2\text{O}=1$): 1.6 @ 20/20°C	pH of Solutions: 6.8 to 8.4
Freezing/Melting Point: -22.3°C -8.2°F	Solubility (Weight % in Water): 0.015% @ 25°C	Bulk Density: 13.6 lbs./gal. @ 20°C	Volume % Volatile: 100
Vapor Pressure: 14.2mmHg @ 20°C	Evaporation Rate (ethyl ether-1): 0.09	Heat of Solution: Not Applicable	Appearance and Odor: Clear, colorless liquid with ether-like odor.

SECTION 2 • HAZARDOUS INGREDIENTS

	%	Hazard Data
Perchloroethylene (Stabilized)	100	See Section 4 & 5

SECTION 3 • FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used) None when tested in accordance with DOT requirements	Flammable Limits in Air (% by Volume) LEL: none UEL: none	Extinguishing Media: For fires involving perchloroethylene use water, dry chemical or carbon dioxide.
---	--	--

Special Fire Fighting Procedures: Fire fighters should wear NIOSH/MSHA-approved pressure-demand self-contained breathing apparatus for possible exposure to hydrogen chloride and possible traces of phosgene.

Unusual Fire and Explosion Hazards: Perchloroethylene involved in fires can decompose to hydrogen chloride and possible traces of phosgene.

SECTION 4 • HEALTH HAZARD DATA

Toxicity Data See Reference 1	Classification (Poison, Irritant, Etc.)
LC ₅₀ Inhalation (rat) 4,000 ppm (4 hours)	Inhalation: Moderately Toxic
LD ₅₀ Dermal Not Determined	Skin Not Determined
Skin/Eye Irritation See Section 5	Skin/Eye: Mildly irritating to skin; eye irritant
LD ₅₀ Ingestion (rabbit) 5000 mg/kg	Ingestion: Slightly Toxic
Fish, LC ₅₀ (Lethal Concentration) 96hr. TLM 100-10 ppm	Aquatic: Toxic

Human Exposure Information/Data: Unconfirmed data exists which indicate that perchloroethylene by ingestion may be more toxic to humans than indicated by the available data. Such unconfirmed data report poisonings at doses as low as 500 mg/kg.

24-HOUR EMERGENCY ASSISTANCE: (313) 358-5800

SECTION 5 - EFFECTS OF OVEREXPOSURE

KML 9015

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Permissible Exposure Limits The individual permissible exposure limits are as follows:

OSHA: 100 ppm, 8-hour TWA (time-weighted average); 100-200 ppm periodic excursions are allowed providing 8-hour TWA is at or below 100 ppm; 200-300 ppm excursions allowed only for maximum of 5 minutes in any 3-hour period; 300 ppm maximum allowable concentration (must not be exceeded); 29CFR 1910.1000.

ACGIH: 50 ppm, 8-hour TWA (time-weighted average); 200 ppm, STEL (15-minute short-term exposure limit)

ACUTE

Inhalation: Perchloroethylene is primarily a central nervous system depressant and can cause possible central nervous system damage with overexposure. Inhalation can cause irritation of the respiratory tract, dizziness, nausea, headache, loss of coordination and equilibrium, unconsciousness and even death in confined or poorly ventilated area. Fatalities following severe acute exposure to various chlorinated solvents have been attributed to ventricular fibrillation.

Eye/Skin: Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes, and skin absorption can occur.

Ingestion: Swallowing of this material may result in irritation of the mouth and GI tract along with other effects as listed above for Inhalation. Vomiting and subsequent aspiration into the lungs may lead to chemical pneumonia and pulmonary edema which is a potentially fatal condition.

CHRONIC

Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. Perchloroethylene has been extensively studied for its cancer potential. There is no documented evidence to suggest that perchloroethylene causes an increased cancer incidence in humans, nor does available information from animal studies suggest that this material poses a carcinogenic risk to humans under conditions adhering to recommended occupational guidelines.

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician. Thoroughly clean contaminated clothing and shoes before reuse or discard.

Ingestion: If conscious, drink large quantities of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital. DO NOT attempt to give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following perchloroethyl overexposure. Increased sensitivity of the heart to adrenalin may be caused by overexposure to perchloroethylene.

SECTION 6. REACTIVITY DATA

Stability: Stable	Conditions to Avoid: Avoid open flames, hot glowing surface or electric arcs.
Hazardous Polymerization: Will not occur	Conditions to Avoid: None

Incompatibility (Materials to Avoid): Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive explosives may be formed.

Hazardous Decomposition Products: Hydrogen chloride and possibly traces of phosgene.

SECTION 7. SPILL OR LEAK PROCEDURES

Steps to be Taken if Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection (See Section 8) should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover spilled material on adsorbents, such as sawdust or vermiculite, and sweep into closed containers for disposal. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much earth and gravel, etc. as necessary and place in closed containers for disposal.

Waste Disposal Method: Contaminated sawdust, vermiculite or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act as well as any other relevant federal, state, or local laws/regulations regarding disposal.

SECTION 8 · SPECIAL PROTECTION INFORMATION

Respiratory Protection: Use a half or full facepiece organic vapor chemical cartridge or canister respirator when concentrations exceed permissible limits. Use self-contained breathing apparatus (SCBA) or full facepiece airline respirator with auxiliary SCBA operated in the pressure-demand mode for emergencies and for all work performed in storage vessels, poorly ventilated rooms, and other confined areas. Respirators must be approved by NIOSH or MSHA. The respirator use limitations made by NIOSH/MSHA⁷ and by the manufacturer must be observed. Respiratory protection programs must be observed. Respiratory protection programs must be in accordance with 29CFR 1910.134.

Ventilation (Type): Use local exhaust or dilution ventilation as appropriate to control exposures to below permissible limits.

Eye Protection: Splashproof goggles

Gloves: Viton , Polyvinyl alcohol*.
For limited service only: Nitrile.
(*degrades in water)

Other Protective Equipment: Boots, aprons, or chemical suits should be used when necessary to prevent skin contact. Personnel protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 · SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined spaces without proper respiratory protection (See Section 8).
- Perchloroethylene vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Store only in closed, properly labeled containers.
- This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES. Handling, storage and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.
- A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable component.
- Do not use cutting or welding torches on drums that contained perchloroethylene unless properly purged and cleaned.

Other Precautions:

- Do not breathe vapors. High vapor concentrations can cause dizziness, unconsciousness, possible central nervous system damage or death. Long-term overexposure may cause liver/kidney injury.
- Use only with adequate ventilation. Ventilation must be sufficient to limit employee exposure to perchloroethylene below permissible exposure limits. Observance of lower limits (outlined in Section 5) is advisable.
- Avoid contact with eyes. Will cause irritation and pain
- Avoid prolonged or repeated contact with skin. May cause irritation or dermatitis.
- Do not swallow. Swallowing may cause injury or death.
- Do not eat, drink, or smoke in work areas.

References:

1. NIOSH registry of Toxic Effects of Chemical Substances, 1978
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fifth Edition, N. I. Sax, 1979
4. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980
5. Encyclopedia of Chemical Technology, Volume 5, Third Edition, Kirk-Othmer, 1979
6. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, DHHS (NIOSH) Publication No. 81-123, January, 1981
7. NIOSH/OSHA Pocket Guide to Chemical Hazards, DHEW (NIOSH) Publication No. 78-210 September, 1978

Comments: As this solvent (perchloroethylene) is used to clean and/or degrease a wide variety of metal and plastic parts, it should always be used in conjunction with properly designed and fully controlled solvent vapor degreasing equipment that is in compliance with the U. S. Environmental Protection Agency, OAQPS Guidelines, "Control of Volatile Organic Emissions from Solvent Metal Cleaning", and/or any other applicable federal, state or local regulatory guidelines.

Perchloroethylene is also used extensively in the commercial drycleaning of clothes. It should always be used in conjunction with properly designed and fully controlled equipment that is in compliance with all applicable federal, state and local regulatory guidelines.

DETREX AUTHORIZED SIGNATURE

James R. Goodrich

UTCML8

PMC 9015

Material Safety Data Sheet

MSD 8208.22

RECEIVED BY

DETREX CHEMICAL INDUSTRIES, INC.
P.O. BOX 501,
DETROIT, MICHIGAN 48232

JUL 18 1983

G. E. PARSONS

Approved by U.S. Dept. of Labor as "Essentially similar" to Form OSHA-20



Date: August, 1982	Edition: First
Chemical Name and Synonyms: Perchloroethylene; tetrachloroethylene CAS No.: 127-18-4	Trade Name and Synonyms: DETREX PERK, Perchlor, Perchloroethylene
Chemical Family: Halogenated Hydrocarbons	Formula: $\text{CCl}_2=\text{CCl}_2$
DOT Shipping Name: Tetrachloroethylene	DOT Hazard Class: ORM-A-UN1897

SECTION 1 - PHYSICAL DATA

Boiling Point @ 760 mm Hg: 250°F 121°C	Vapor Density (Air=1): 5.83	Specific Gravity ($\text{H}_2\text{O}=1$): (20°/20°C) 1.6	pH of Solutions: 6.8 to 8.4
Freezing/Melting Point: -8.2°F -22.3°C	Solubility (Weight % in Water): @25°C 0.015%	Bulk Density: 13.6 lbs./gal. @ 20°C	Volume % Volatile: Essentially 100
Vapor Pressure: @ 20°C = 14.2mmHg	Evaporation Rate (ethyl ether=1): 0.09	Heat of Solution: Not Applicable	Appearance and Odor: Clear, colorless liquid with ether-like odor.

SECTION 2 - HAZARDOUS INGREDIENTS

	%	Hazard Data
Perchloroethylene (Stabilized)	100	See Sections 4 & 5

SECTION 3 - FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used) None	Flammable Limits in Air (% by Volume) None LEL: UEL: =	Extinguishing Media: For fires involving perchloroethylene, use water, dry chemical or carbon dioxide.
--------------------------------------	--	---

Special Fire Fighting Procedures: Fire fighters should wear pressure-demand self-contained breathing apparatus for possible exposure to hydrogen chloride and possible traces of phosgene.

Unusual Fire and Explosion Hazards: Perchloroethylene involved in fires can decompose to hydrogen chloride and possible traces of phosgene. See Detrex warning letter Form SoL 8208.21 attached.

SECTION 4 - HEALTH HAZARD DATA

Permissible Exposure Limits (TLV): See Section 5

Toxicity Data Ref. (1)	Classification (Poison, Irritant, Etc.)
LC ₅₀ Inhalation (rat) 4,000 ppm (4 hours)	Inhalation: Moderately Toxic
LD ₅₀ Dermal	Skin/Eye: Liquid mildly irritating to skin; eye irritant
LD ₅₀ Ingestion (rabbit) - 5,000 mg/kg	Ingestion: Slightly Toxic
Fish, LC ₅₀ (Lethal Concentration) 96hr. TLM 100-10 ppm	Aquatic: Toxic

Human Exposure Information/Data: Unconfirmed data exists which indicate that perchloroethylene by ingestion may be more toxic to humans than indicated by the available data. Such unconfirmed data report poisonings at doses as low as 500 mg/kg.

24-HOUR EMERGENCY ASSISTANCE: (313) 358-5800

Section 4(Cont'd)- Permissible Exposure Limits

PMC 9015

Current OSHA permissible exposure limits (29CFR 1910.1000) are 100 ppm (8-hour TWA);
100-200 ppm periodic excursions are allowed providing 8-hour TWA is at or below 100 ppm;
200-300 ppm excursions allowed only for maximum of 5 minutes in any 3-hour period;
300 ppm maximum allowable concentration (must not be exceeded).

SECTION 5 - EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Acute: Primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory tract, dizziness, nausea, headache, loss of coordination and equilibrium, unconsciousness and if exposed to high concentrations in confined or poorly ventilated areas, even death.

Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes. Skin absorption can occur.

Chronic: Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. Perchloroethylene has been extensively studied for cancer both in the U.S. and Europe by government, industry and academia. There is no documented evidence that perchloroethylene causes an increased cancer incidence in humans

EMERGENCY AND FIRST AID PROCEDURES:

PMC 9015

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician.

Ingestion: If conscious, drink a quart of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital or physician. DO NOT give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following perchloroethylene overexposure. Increased sensitivity of the heart to adrenalin may be caused by overexposure to perchloroethylene.

SECTION 6 - REACTIVITY DATA

Stability: Stable	Conditions to Avoid: Avoid open flames, hot glowing surfaces or electric arc.
Hazardous Polymerization: Will not occur	Conditions to Avoid: None

Incompatibility (Materials to Avoid): Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive explosives may be formed. Also see Detrex warning letter Form Sol 8208.21 attached.

Hazardous Decomposition Products: Hydrogen chloride and possibly traces of phosgene.

SECTION 7 - SPILL OR LEAK PROCEDURES (See Detrex Forms Sol 8208.14 and Sol 8208.15 attached)

Steps to be Taken if Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover or absorb spilled material on sawdust or vermiculite and sweep into closed containers for disposal. After all visible traces have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc., as necessary and place in closed containers for disposal. (See Below)

Waste Disposal Method:

Contaminated sawdust, vermiculite or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers to prevent environmental contamination. It is your duty to dispose of the chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act and all relevant state or local laws/regulations regarding disposal.

SECTION 8 • SPECIAL PROTECTION INFORMATION

Respiratory Protection: For emergencies or working in confined areas, wear self-contained breathing apparatus or supplied air respiratory protection (use the "buddy system" and wear a safety harness with a lifeline). In other circumstances involving potential overexposures, use NIOSH/MSHA-approved organic vapor respirator. (Observe limitations directed by manufacturer.) Respiratory protection program must be in accordance with 29CFR 1910.134.

Ventilation (Type: Mechanical (General)) - Sufficient to maintain workplace concentration below permissible exposure limits.

Eye Protection: Splashproof goggles

Gloves: Polyethylene, neoprene or polyvinyl

Other Protective Equipment: Safety shower and eye-wash fountain in immediate area. Personnel protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 • SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined spaces.
- Perchloroethylene vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Do not store in open, unlabeled or mislabeled containers.
- Liquid oxygen or other strong oxidants may form explosive mixtures with perchloroethylene.
- This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and traces of phosgene.
- **AVOID CONTAMINATION OF WATER SUPPLIES:** Handling, storage and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.

Other Precautions:

- **AVOID PROLONGED OR REPEATED BREATHING OF VAPORS.** High vapor concentrations can cause dizziness, unconsciousness or death. Long-term overexposure may cause liver/kidney injury.
- **USE ONLY WITH ADEQUATE VENTILATION.** Ventilation must be sufficient to limit employee exposure to perchloroethylene below OSHA permissible exposure limit (8-hour TWA - 100 ppm; ceiling 200 ppm; maximum peak 300 ppm, 5 minutes in any 3 hours). Observance of lower limits (outlined in Section 4) is advisable.
- **AVOID CONTACT WITH EYES.** Will cause irritation and pain.
- **AVOID PROLONGED OR REPEATED CONTACT WITH SKIN.** May cause irritation or dermatitis.
- **DO NOT TAKE INTERNALLY.** Swallowing may cause injury or death.
- **DO NOT EAT, DRINK OR SMOKE IN WORK AREAS.**

References:

1. NIOSH Registry of Toxic Effects of Chemical Substances, 1978
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F.A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fifth Edition, N. I. Sax, 1979
4. Federal Register, 45FR Hazardous Waste Management Systems Part III, Identification and Listing of Hazardous Wastes, Page 33084, May 19, 1980
5. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980

Comments: As this solvent (perchloroethylene) is used to clean and/or degrease a wide variety of metal and plastic parts, it should always be used in conjunction with properly designed and fully controlled solvent vapor degreasing equipment that is in compliance with the U. S. Environmental Protection Agency, OAQPS Guidelines, "Control of Volatile Organic Emissions from Solvent Metal Cleaning", and/or any other applicable federal, state or local regulatory guidelines.

Perchloroethylene is also used extensively in the commercial drycleaning clothes. It should always be used in conjunction with properly designed and fully controlled equipment that is in compliance with all applicable federal, state and local regulatory guidelines.

UTC IHL

PMC 4015 9088

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JUL 11 1980 8P 982

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G. E. PARSONS -

M A T E R I A L S A F E T Y D A T A S H E E T PAGE: 1
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 12 FEB 80

PRODUCT CODE: 59010

PRODUCT NAME: PERCHLOROETHYLENE SVG

MSD: 0475

INGREDIENTS (TYPICAL VALUES-NOT SPECIFICATIONS)

: : :

PERCHLOROETHYLENE

: 99 : :

SECTION 1

PHYSICAL DATA

BOILING POINT: 250F (121C) : SOL. IN WATER: 0.015G/100G 25C
VAP PRESS: 13 MMHG @ 20C : SP. GRAVITY: 1.612-1.619 @ 25/25C
VAP DENSITY (AIR=1): 5.76 : % VOLATILE BY VOL: 100 (ESSENTIALLY)
APPEARANCE AND ODOR: COLORLESS LIQUID.

SECTION 2

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE : FLAMMABLE LIMITS (STP IN AIR)
METHOD USED: TCC, TCC, CCG : LFL: NONE UFL: NONE
EXTINGUISHING MEDIA: NON-FLAMMABLE MATERIAL.
SPECIAL FIRE FIGHTING EQUIPMENT AND HAZARDS: PRESSURE DEMAND
SELF-CONTAINED RESPIRATORY EQUIPMENT.

SECTION 3

REACTIVITY DATA

STABILITY: AVOID OPEN FLAMES, WELDING ARCS, OR OTHER
HIGH TEMPERATURE SOURCES WHICH INDUCE THERMAL DECOMPOSITION.
INCOMPATIBILITY: ----
HAZARDOUS DECOMPOSITION PRODUCTS: INVOLVEMENT IN FIRE FORMS HYDROGEN
CHLORIDE AND SMALL AMOUNTS OF PHOSGENE AND CHLORINE.
HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

SECTION 4

SPILL, LEAK, AND DISPOSAL PROCEDURES

ACTION TO TAKE FOR SPILLS (USE APPROPRIATE SAFETY EQUIPMENT): SMALL LEAKS -
WIP UP, WIPE UP, OR SOAK UP IMMEDIATELY. REMOVE TO OUT OF LOCUS.
LARGE SPILLS - EVACUATE AREA. CONTAIN LIQUID; TRANSFER TO CLOSED
METAL CONTAINERS. KEEP OUT OF WATER SUPPLY.
DISPOSAL METHOD: SEND SOLVENT TO RECLAIMER. IN SOME CASES, SMALL
AMOUNTS MAY BE TRANSPORTED TO AN AREA WHERE IT CAN BE PLACED ON THE
GROUND AND ALLOWED TO EVAPORATE SAFELY IF LOCAL, STATE AND FEDERAL
REGULATIONS PERMIT.

(CONTINUED ON PAGE 2)

(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

SEP 982

07 -

PMC 9015 9088

M A T E R I A L S A F E T Y D A T A S H E E T P A G E : 2
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 12 FEB 80
PRODUCT (CONT'D): PERCHLOROETHYLENE SV6

PRODUCT CODE: 59010
MSC: 0475

SECTION 5

HEALTH HAZARD DATA

INGESTION: LOW IN SINGLE DOSE ORAL TOXICITY. LD50 (RAT) GREATER THAN 5000 (MOUSE) IN RANGE OF 8000 TO 11000 MG/KG.
EYE CONTACT: PAIN AND IRRITATION, BUT NO CORNEAL INJURY SHOULD OCCUR.
SKIN CONTACT: SHORT CONTACT - NO IRRITATION. PROLONGED OR FREQUENTLY REPEATED CONTACT - MODERATE IRRITATION AND DRYING. IF CONFINED TO SKIN - PAIN AND IRRITATION, EVEN A BURN.
SKIN ABSORPTION: LOW TOXICITY. LD50 (RABBIT) GREATER THAN 11 G/KG.
INHALATION: ACCIDENTAL AND OSHA GUIDE IS 100 PPM.
EFFECTS OF OVEREXPOSURE: POSSIBLE ORGANIC INJURY FROM PROLONGED OR REPEATED EXPOSURES; IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION. CAN CAUSE DEATH IF TOO MUCH IS BREATHED.

SECTION 6

FIRST AID--NOTE TO PHYSICIAN

FIRST AID PROCEDURES:

EYES: IRRIGATION OF THE EYES IMMEDIATELY WITH WATER FOR FIVE MINUTES IS GOOD SAFETY PRACTICE.
SKIN: WASH OFF IN FLOWING WATER OR SHOWER 15 MINUTES. CONSULT MEDICAL. THOROUGHLY AIR DRY OR WASH GROSSLY CONTAMINATED CLOTHES BEFORE REUSE.
INHALATION: REMOVE TO FRESH AIR IF EFFECTS OCCUR. IF RESPIRATION STOPS, GIVE MOUTH-TO-MOUTH RESUSCITATION. CALL PHYSICIAN AND/OR TRANSPORT TO MEDICAL FACILITY.
INGESTION: DO NOT INDUCE VOMITING. CALL A PHYSICIAN OR TRANSPORT TO EMERGENCY FACILITY.

NOTE TO PHYSICIAN:

EYES: MAY PRODUCE CONJUNCTIVITIS. STAIN FOR EVIDENCE OF CORNEAL ABRASION OR INJURY.
SKIN: CHRONIC EXPOSURE MAY PRODUCE DEFATTING TYPE OF DERMATITIS. TREAT AS ANY CONTACT DERMATITIS; IRRITATOR IS KNOWN OR SUSPECTED SKIN SENSITIZER.
RESPIRATORY: MODERATE IRRITANT. BRONCHODILATORS, EXPECTORANTS AND ANTITUSSIVES MAY BE OF HELP. OXYGEN MAY BE HELPFUL. MECHANICAL SUPPORT OF RESPIRATION MAY BE NEEDED.
ORAL: MAY CAUSE CHEMICAL PNEUMONITIS IF ASPIRATED INTO LUNGS. PRODUCT LOW IN TOXICITY. DANGER OF CHEMICAL PNEUMONIA MUST BE WEIGHED AGAINST TOXICITY. IF LAVAGE IS PERFORMED, SUGGEST ENDO-TRACHEAL AND/OR ESOPHAGOSCOPIC CONTROL.
SYSTEMIC: ANESTHETIC OR NARCOTIC EFFECT MAY OCCUR. MAY INCREASE MYOCARDIAL IRRITABILITY. AVOID EPINEPHRINE OR SIMILAR ACTING DRUGS IF AT ALL POSSIBLE. MAY CAUSE NAUSEA OR VOMITING. ALCOHOL CONSUMED BEFORE OR AFTER EXPOSURE MAY INCREASE INJURY. NO SPECIFIC ANTIDOTE. LIVER AND KIDNEY CHANGES SHOWN IN ANIMAL STUDIES. OTHER STUDIES SUGGEST IT MAY BE CARCINOGENIC AND EMBRYOTOXIC IN ANIMALS. CONSULT STANDARD LITERATURE.

(CONTINUED ON PAGE 3)

(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

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M A T E R I A L S A F E T Y D A T A S H E E T P A G E : 3
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400

EFFECTIVE DATE: 12 FEB 80
PRODUCT (CONT'D): PERCHLOROETHYLENE SVG

PRODUCT CODE: 59010
MSD: 0475

SECTION 7 SPECIAL HANDLING INFORMATION

VENTILATION: RECOMMEND CONTROL OF VAPORS TO SUGGESTED GUIDE.
GOOD ROOM VENTILATION USUALLY ADEQUATE FOR MOST OPERATIONS.
RESPIRATORY PROTECTION: APPROVED RESPIRATORY PROTECTION
REQUIRED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. FOR EMERGEN-
CIES, A SELF-CONTAINED BREATHING APPARATUS OR A FULL-FACE RESPIRATOR
IS RECOMMENDED.
PROTECTIVE CLOTHING: NONE REQUIRED.
EYE PROTECTION: SAFETY GLASSES WITHOUT SIDE SHIELDS.

SECTION 8 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: HANDLE WITH REASONABLE
CARE AND CAUTION. AVOID BREATHING VAPORS. VAPORS OF THIS PRODUCT
ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS SUCH AS PITS,
DEGREASERS, STORAGE TANKS, AND OTHER CONFINED AREAS. DO NOT ENTER
THESE AREAS WHERE VAPORS OF THIS PRODUCT ARE SUSPECTED UNLESS
SPECIAL BREATHING APPARATUS IS USED AND AN OBSERVER IS PRESENT FOR
ASSISTANCE.

ADDITIONAL INFORMATION: REVISIONS 2/12/80 -- SECTIONS 6 AND 7.

LAST PAGE

(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH, BUT NO WARRANTY,
EXPRESSED OR IMPLIED, IS MADE.

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Ethyl Corporation

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APR 21 1980

MATERIAL SAFETY DATA SHEET

(Essentially Similar To Form OSHA-201)

REV. MAY 78

G. E. PARSONS

SECTION I	
ETHYL CORPORATION	EMERGENCY TELEPHONE NO. 504/344-7147
ADDRESS P.O. Box 341, Baton Rouge, Louisiana 70821	
CHEMICAL NAME AND SYNONYMS Tetrachloroethylene (Perchloroethylene)	TRADE NAME AND SYNONYMS Perchloroethylene; Per
CHEMICAL FAMILY Chloroethylene	FORMULA CCl ₂ :CCl ₂

SECTION II - HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (mg/m ³)	ALLOYS AND METALLIC COATINGS	%	TLV (mg/m ³)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES Stabilizers			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (mg/m ³)

SECTION III - PHYSICAL DATA			
BOILING POINT (°F.) (760 mm)	250.16	SPECIFIC GRAVITY (H ₂ O=1) 15°/4°C	1.631
VAPOR PRESSURE (mm Hg.) 22°C (72°F)	15.8	PERCENT VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR=1)	5.83	EVAPORATION RATE (CCl ₄ =1)	0.25
SOLUBILITY IN WATER 77°F, wt %	0.015		
APPEARANCE AND ODOR	Colorless, clear, heavy liquid with a pleasant ethereal odor.		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA			
FLASH POINT (MHRS USED)	None	FLAMMABLE LIMITS	LM UM
		Nonflammable	
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS			
With outside fuel source, combustion products can contain HCl and traces of phosgene.			

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CHEMICAL OR TRADE NAME Perchloroethylene; Per

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE For 8-hour day - 100 ppm time-weighted average; 200 ppm ceiling (OSHA). ACGIH (1979) - 100 ppm TWA (can be absorbed through skin).

EFFECTS OF OVEREXPOSURE Irritation, lachrymation and burning of the eyes, vomiting, nausea, drowsiness; acts as an intoxicant and an anesthetic. Avoid prolonged or repeated contact with skin to prevent skin irritation and dermatitis. Limited gavage studies suggest Per may be a cancer-suspect agent in animals.

EMERGENCY AND FIRST AID PROCEDURES Remove person from contaminated area; apply artificial respiration and oxygen if breathing has stopped. Consult a physician (NOTE: Epinephrine is contraindicated). Remove contaminated clothing and wash skin with warm soap and water. If taken internally, do not induce vomiting. If eyes have been contacted, wash with copious quantities of water-call a physician.

SECTION VI - REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Open flames, electric heaters, etc.
	STABLE	X	
INCOMPATIBILITY (Materials to avoid) Rubber and plastic are damaged by long contact.			
HAZARDOUS DECOMPOSITION PRODUCTS At very high temperatures, can decompose to toxic chlorinated products.			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Spilled perchloroethylene may be removed by mopping or absorbing with rags. Provide adequate ventilation. Clothing wet with perchloroethylene should be removed immediately and the affected area washed with soap and water.

WASTE DISPOSAL METHOD Residue from distillations of perchlorethylene may be poured on dry sand, earth, or ashes at a safe distance from occupied areas and allowed to evaporate. An impermeable barrier such as metal or concrete should be placed between the dry sand, earth or ashes and the soil. State and local pollution control agencies should be consulted.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Canister type gas mask, self-contained air mask.		
VENTILATION	LOCAL EXHAUST Floor level ventilation	SPECIAL
	MECHANICAL (General) Downdraft	OTHER
PROTECTIVE GLOVES Neoprene, PVC-coated or Viton		EYE PROTECTION Chemical safety goggles
OTHER PROTECTIVE EQUIPMENT Protective headgear and apron when splashing could be a problem.		

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Storage tanks should be adequately vented for filling and pressure equalization. Vents from indoor tanks should terminate outdoors.

OTHER PRECAUTIONS
Floor level ventilation should be provided. Avoid contact with skin and avoid vapors. No smoking in presence of vapors.

DATE Nov. 12, 1979

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M A T E R I A L S A F E T Y D A T A S H E E T 41

PPG INDUSTRIES, INC. ONE PPG PLACE PITTSBURGH, PA 15272
 24-HOUR EMERGENCY ASSISTANCE: (304) 843-1300

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APPROVED BY U.S. DEPT. OF LABOR AS "ESSENTIALLY SIMILAR" TO FORM OSHA-20

EFFECTIVE DATE: NOVEMBER 1, 1985 EDITION: 6

UTC IHL /6

CHEMICAL NAME AND SYNONYMS:
 PERCHLOROETHYLENE
 TETRACHLOROETHYLENE
 CAS NO. 127-18-4

RECEIVED

FEB 14 1986

TRADE NAME:
 PERCHLOR-DGREAS

INDUSTRIAL HYGIENE

CHEMICAL FAMILY:
 HALOGENATED HYDROCARBONS

FORMULA:
 $\text{CCL}_2 = \text{CCL}_2$

DOT SHIPPING NAME:
 PERCHLOR-DGREAS HD

DOT HAZARD CLASS:
 SEE COMMENTS

REPORTABLE QUANTITY: I.D. NUMBER:
 N/A COMNTS

SUBSIDIARY RISK:
 N/A

 * SECTION 1 PHYSICAL DATA

BOILING POINT @760MM HG 121 C	VAPOR DENSITY (AIR=1) 5.83	SPECIFIC GRAVITY (H2O=1) 1.6 @ 20/20 C	PH OF SOLUTIONS 6.8 TO 8.4
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FREEZING/MELTING POINT -22.3 C	SOLUBILITY (WEIGHT% IN WATER) 0.015% @ 25 C	BULK DENSITY 13.6 LB/G @20 C	VOLUME % VOLATI 100
--------------------------------------	---	---------------------------------	------------------------

VAPOR PRESSURE: 14.2 MMHG @ 20 C	EVAPORATION RATE: (ETHYL ETHER=1): 0.09	HEAT OF SOLUTION N/A
-------------------------------------	--	-------------------------

APPEARANCE AND ODOR:
 CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR.

 * SECTION 2 INGREDIENTS

INGREDIENT:	%	INGREDIENT:	%
PERCHLOROETHYLENE (STABILIZED)	99	NOTE: HAZARD INFO IS BASED ON TEST MIX & NOT INDIV INGRED	

 * SECTION 3 FIRE AND EXPLOSION HAZARD DATA

FLASH POINT DEG F (METHOD USED) NONE PER DOT TEST	FLAMMABLE LIMITS IN AIR(% BY VOLUME) LEL: NONE UEL: NONE
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EXTINGUISHING MEDIA:
 WATER, DRY CHEMICALS, OR CARBON DIOXIDE

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SPECIAL FIRE FIGHTING PROCEDURES:

FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA-APPROVED PRESSURE-DEMAND SELF CONTAINED
BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE
TRACES OF PHOSGENE

UNUSUAL FIRE AND EXPLOSION HAZARDS:

PERCHLOR INVOLVED IN FIRES CAN DECOMPOSE TO HYDROGEN CHLORIDE AND POSSIBLE
TRACES OF PHOSGENE.

* SECTION 4 HEALTH HAZARD DATA

TOXICITY DATA: SEE REFERENCE (1)

CLASSIFICATION (POISON, IRRITANT, ETC.)

LD50 INHALATION:
(RAT) 4000 PPM (4 HOURS)

INHALATION:
MODERATELY TOXIC

LD50 DERMAL:
NOT DETERMINED

SKIN:
NOT DETERMINED

SKIN/EYE IRRITATION:
SEE SECTION 5

SKIN:
MILDLY IRRITATING

EYE:
IRRITANT

LD50 INGESTION:
(RABBIT) 5000 MG/KG

INGESTION:
SLIGHTLY TOXIC

FISH LD50 (LETHAL CONCENTRATION):
96 HR TLM: 100-10 PPM

AQUATIC:
TOXIC

* SECTION 5 EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT,
INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST
HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE

PERMISSIBLE EXPOSURE LIMITS:

THE INDIVIDUAL PERMISSIBLE EXPOSURE LIMITS ARE AS FOLLOWS:

OSHA: 100 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 100-200 PPM PERIODIC EX-
CURSIONS ARE ALLOWED PROVIDING 8-HOUR TWA IS AT OR BELOW 100 PPM;
200-300 PPM EXCURSIONS ALLOWED ONLY FOR MAXIMUM OF 5 MINUTES IN ANY
8-HOUR PERIOD; 300 PPM MAXIMUM ALLOWABLE CONCENTRATION (MUST NOT BE
EXCEEDED); 29CFR 1910.1000.

ACGIH: 50 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 200 PPM, STEL (15-MINUTE
SHORT-TERM EXPOSURE LIMIT)

PPG INTERNAL PERMISSIBLE EXPOSURE LIMIT: 50 PPM, 8-HOUR TWA (TIME WEIGHTED
AVERAGE); 100 PPM, STEL (15-MINUTE SHORT-TERM EXPOSURE LIMIT)

ACUTE

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INHALATION: PERCHLOROETHYLENE IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESS-
ANT AND CAN CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE WITH OVEREXPOSURE.
INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY TRACT, DIZZINESS, NAUSEA,
HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS AND EVEN
DEATH IN CONFINED OR POORLY VENTILATED AREA. FATALITIES FOLLOWING SEVERE
ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO
VENTRICULAR FIBRILLATION.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN &
IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE
IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING
TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN
ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH
AND GI TRACT ALONG WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION.
VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL
PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION.

CHRONIC

A RECENT NTP STUDY HAS DETERMINED THAT THERE IS CLEAR EVIDENCE OF CARCINO-
GENICITY (LIVER) IN BOTH MALE & FEMALE MICE, CLEAR EVIDENCE OF LEUKEMIA IN
MALE & FEMALE RATS & SOME EVIDENCE OF ANIMAL CARCINOGENICITY (KIDNEY TUMORS)
IN MALE RATS. THE NTP STUDY EXPOSED RATS TO 200 & 400 PPM & MICE TO 100 TO
200 PPM IN A LIFETIME STUDY. AT THE PRESENT TIME, IARC LISTS PERCHLOR IN
GROUP 3 (8). UNTIL MORE INFORMATION REGARDING THIS NTP STUDY IS AVAILABLE,
PRUDENT HANDLING PRACTICE SHOULD MINIMIZE HUMAN EXPOSURE.

: EMERGENCY AND FIRST AID PROCEDURES

INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION,
PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL
A PHYSICIAN.

EYE OR SKIN CONTACT:

FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT
LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF
IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED
CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:

IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING.
TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN
CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING
BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN INCLUDING ANTIDOTES:

NEVER ADMINISTER ADRENALIN FOLLOWING PERCHLOROETHYLENE OVEREXPOSURE.
INCREASED SENSITIVITY OF THE HEART TO ADRENALIN MAY BE CAUSED BY OVER -
EXPOSURE TO PERCHLOROETHYLENE.

SECTION 6 REACTIVITY DATA

STABILITY:

STABLE

CONDITIONS TO AVOID:

AVOID OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS.

HAZARDOUS POLYMERIZATION:

WILL NOT OCCUR.

CONDITIONS TO AVOID:

NONE

INCOMPATIBILITY (MATERIALS TO AVOID):

NONE

HAZARDOUS DECOMPOSITION PRODUCTS:

HYDROGEN CHLORIDE AND POSSIBLY TRACES OF PHOSGENE.

SECTION 7 SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:

IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ABSORBENTS, SUCH AS SAWDUST OR VERMICULITE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THOROUGHLY WET VACUUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

WASTE DISPOSAL METHOD:

CONTAMINATED SAWDUST, VERMICULITE OR POROUS SURFACE MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE RE-PROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

RCRA - HAZARDOUS WASTE NUMBER - U-210

SECTION 8 SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED

BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILIARY SCBA OPERATED IN THE PRESSURE-DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA (6)(7) AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 29CFR 1910.134.

VENTILATION(TYPE):

USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS

EYE PROTECTION:

SPLASHPROOF GOGGLES

GLOVES:

SEE COMMENTS

OTHER PROTECTIVE EQUIPMENT:

BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29CFR 1910.133 AND 29CFR 1910.132.

* SECTION 9 SPECIAL PRECAUTIONS *

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:

1. DO NOT USE IN POORLY VENTILATED OR CONFINED SPACES WITHOUT PROPER RESPIRATORY PROTECTION (SEE SECTION 8).
2. PERCHLOROETHYLENE VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
3. KEEP CONTAINER CLOSED WHEN NOT IN USE.
4. STORE ONLY IN CLOSED, PROPERLY LABELED CONTAINERS.
5. THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE GAS AND TRACES OF PHOSGENE.
6. AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE AND USE PROCEDURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY CORRECTED
7. A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
8. DO NOT USE CUTTING OR WELDING TORCHES ON DRUMS THAT CONTAINED PERCHLOROETHYLENE UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

1. DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE LIVER/KIDNEY INJURY.
2. USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO PERCHLOROETHYLENE BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE.
3. AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.

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4. AVOID PROLONGED OR REPEATED CONTACTS WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
5. DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
6. DO NOT EAT, DRINK, OR SMOKE IN WORK AREAS.

REFERENCES:

1. NIOSH REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES, 1978
2. INDUSTRIAL HYGIENE AND TOXICOLOGY, VOLUME II, SECOND EDITION, F.A. PATTY, 1963.
3. DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS, FIFTH EDITION, N. I. SAX, 1979
4. EPA SCIENCE ADVISORY BOARD, SUBCOMMITTEE ON AIRBORNE CARCINOGENS, SEPTEMBER, 1980
5. ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY, VOLUME 5, THIRD EDITION, KIRK-OTTMER, 1979
6. NIOSH/OSHA OCCUPATIONAL HEALTH GUIDELINES FOR CHEMICAL HAZARDS, DHHS (NIOSH) PUBLICATION NO. 81-123, JANUARY, 1981
7. NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS, DHEW (NIOSH) PUBLICATION NO. 78-210, SEPTEMBER, 1978
8. INTERNATIONAL AGENCY FOR RESEARCH OF CANCER, ANNUAL REPORT, 1982

COMMENTS:

DOT HAZARD CLASS

ONLY REGULATED WHEN SHIPPED BY AIR. DOT SHIPPING NAME IS TETRACHLOROETHYLENE
DOT HAZARD CLASS IS ORM--A, AND UN NUMBER IS UN1897.

SECTION 8 - SPECIAL PROTECTION INFORMATION

GLOVES: VITON, POLYVINYL ALCOHOL*. FOR LIMITED SERVICE
ONLY: NITRILE * (DEGRADES IN WATER)



UTC

MATERIAL SAFETY DATA SHEET

(Approved by U.S. Department of Labor "Essentially Similar" to Form LSS-008-4)

SEP 9 '82

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CHEMICAL NAME: EPICHLORHYDRIN

SYNONYMS: α -Epichlorhydrin; 1-Chloro-2,3-epoxypropene;
 γ -Chloropropylene Oxide; (Chloromethyl)oxirane

CHEMICAL FAMILY: Chlorine Compounds and Oxide

FORMULA: $\text{OCH}_2\text{CHCH}_2\text{Cl}$

MOLECULAR WEIGHT: 92.53

TRADE NAME AND SYNONYMS: Epichlorhydrin

I. PHYSICAL DATA

BOILING POINT, 760 mm. Hg	115.2°C. (239.4°F.)	FREEZING POINT	-58.1°C.
SPECIFIC GRAVITY ($\text{H}_2\text{O} = 1$)	1.1825 at 20/20°C.	VAPOR PRESSURE at 20°C.	13 mm. Hg
VAPOR DENSITY (air = 1)	3.29	SOLUBILITY IN WATER, % by wt. at 20°C.	6.4
PER CENT VOLATILES BY VOLUME	100	EVAPORATION RATE (Butyl Acetate = 1)	1.36
APPEARANCE AND ODOR	Water-white liquid; characteristic odor.		

II. HAZARDOUS INGREDIENTS

MATERIAL	%	TLV (Units)
Not applicable		
COPY TO LOCAL I.A.M.		
JUL 8 '82 1746		

III. FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (test method)	93°F., Tag open cup	AUTOIGNITION TEMPERATURE	804°F.
FLAMMABLE LIMITS IN AIR, % by volume	LOWER	3.3 (calculated)	UPPER 14.5 (calculated)
EXTINGUISHING MEDIA	Carbon dioxide or dry chemical for small fires. Polymer foam for large fires.		
SPECIAL FIRE FIGHTING PROCEDURES	Avoid use of dry chemical extinguishing agents if fire occurs in container with confined vent. Avoid use of carbon tetrachloride extinguishing agents.		
UNUSUAL FIRE AND EXPLOSION HAZARDS	Avoid contamination with copper or lead. Avoid mixing with acids, alkalies, and metal halides.		

EMERGENCY PHONE NUMBERS

Dr. C. U. Denehl, 212/551-4785; 914/946-0646 (night)
Dr. K. S. Lane, 212/551-4787; 914/666-3656 (night)
C. P. Carpenter, Ph.D., 412/327-1020; 412/241-7896 (night)

Legal responsibility is assumed only for the fact that all studies reported here and all opinions are those of qualified experts.

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IV. HEALTH HAZARD DATA

SEP 9 '82 07

THRESHOLD LIMIT VALUE	5 ppm. (Skin)
EFFECTS OF OVEREXPOSURE	Vapor is irritating to eyes, nose, and throat. Causes sore throat, headache, nausea, and vomiting. Skin contact is irritating. Rapidly fatal if swallowed; i.e., nausea, vomiting, and collapse.
EMERGENCY AND FIRST AID PROCEDURES	If swallowed, induce vomiting immediately and call a physician. If inhaled, remove to fresh air. Give oxygen if breathing is difficult. Call a physician. Flush skin and eye contact with water for at least 15 minutes. Get medical care for eyes. Remove contaminated clothing.

V. REACTIVITY DATA

STABILITY		CONDITIONS TO AVOID	Heat and flames.
UNSTABLE	STABLE		
—	✓		
INCOMPATIBILITY (materials to avoid)		Avoid contamination with alkalis, acids, and metal halides.	
HAZARDOUS DECOMPOSITION PRODUCTS		None	
HAZARDOUS POLYMERIZATION		CONDITIONS TO AVOID	Presence of alkalis, acids, polymerization catalysts, and high temperatures.
May Occur	Will not Occur		
✓	—		

VI. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED	Flush away spilled material with large volumes of water.
WASTE DISPOSAL METHOD	Incinerate in a furnace. Care should be exercised to dissipate combustion products. Hydrogen chloride is generated.

COPY TO LOCAL I.A.M.

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VII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (specify type)		Air-supplied mask	
VENTILATION	LOCAL EXHAUST	Preferable	SPECIAL —
	MECHANICAL (general)	Acceptable	OTHER —
PROTECTIVE GLOVES		Plastic gloves	EYE PROTECTION Monogoggles
OTHER PROTECTIVE EQUIPMENT		Face shield, apron, eyebath, and safety shower	

VIII. SPECIAL PRECAUTIONS

PRECAUTIONARY LABELING



EPICHLORHYDRIN



POISON



DANGER! MAY BE HARMFUL OR FATAL
IF INHALED OR SWALLOWED.

MAY CAUSE EYE AND SKIN
IRRITATION.

COMBUSTIBLE.

- Do not breathe vapor.
- Do not take internally.
- Do not get on skin, on clothing,
or in eyes.
- Do not rely on rubber or other
gloves for protection.
- Keep away from heat, sparks, and fire.

IN CASE OF CONTACT:

CLOTHING — Remove contaminated
clothing and shoes at once.

Wash thoroughly before reuse.

SKIN — Immediately wash skin with
soap and plenty of water.

EYES — Immediately flush with plenty
of water for at least 15 minutes.
Get medical attention.

FIRST AID TREATMENT

IF SWALLOWED: Make patient vomit
immediately (finger down throat or,
if conscious, give warm mustard
water or salt water freely).

GENERAL: Keep patient warm; if
conscious, give coffee; call physician.
Do not give Adrenalin.

FOR INDUSTRY USE ONLY

OTHER HANDLING AND
STORAGE CONDITIONS

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9015
Form No. 155-005-1
May 1988Form Approved
Budget Bureau No. 44-R1387
Approval Expires April 30, 1971U.S. DEPARTMENT OF LABOR
WORKPLACE STANDARDS ADMINISTRATION
Bureau of Labor Standards

MATERIAL SAFETY DATA SHEET

rec'd. 9-22-75
old MSDS in file

R.C. White, Gen'l. Mgr., Solvent Div. SECTION I

MANUFACTURER'S NAME Source of Data: DETREX CHEMICAL IND., INC.		EMERGENCY TELEPHONE NO. Area 313 868-8600
ADDRESS (Number, Street, City, State, and ZIP Code) Box 501 Detroit, Michigan 48232		
CHEMICAL NAME AND SYNONYMS Perchloroethylene (tetrachloroethylene)		TRADE NAME AND SYNONYMS DETREX PERK or Kem-O-Dry
CHEMICAL FAMILY Chlorinated Hydrocarbon	FORMULA CCl ₂ CCl ₂	

SECTION II HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS	100	100	FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
Perchloroethylene				99.76	%
Epichlorohydrin				0.24	%

SECTION III PHYSICAL DATA			
BOILING POINT (°F.)	250	SPECIFIC GRAVITY (H ₂ O=1)	1.62
VAPOR PRESSURE (mm Hg.)	15	PERCENT VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR=1)	5.83	EVAPORATION RATE (1-ETHEREAL=1)	.09
SOLUBILITY IN WATER	Negligible		
APPEARANCE AND ODOR	Clear, colorless liquid with a characteristic mild ethereal odor.		

SECTION IV FIRE AND EXPLOSION HAZARD DATA			
FLASH POINT (Method used)	None	FLAMMABLE LIMITS	Loi Uoi
EXTINGUISHING MEDIA	D.C.		
SPECIAL FIRE FIGHTING PROCEDURES	COPY TO LOCAL I.A.M.		
UNUSUAL FIRE AND EXPLOSION HAZARDS	1746		

COPY TO LOCAL I.A.M.

COPY TO LOCAL I.A.M.

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SECTION V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE 100ppm

EFFECTS OF OVEREXPOSURE Over exposure may lead to slight anesthetic feeling, possible irritation to eyes, nose and throat. Continued exposure can result in headaches, fatigue, dizziness, nausea and gradual suppression of consciousness.

EMERGENCY AND FIRST AID PROCEDURES Move patient to fresh air and if unconscious give artificial respiration or oxygen. Any clothing that has been wet with the solvent liquid should be removed, the skin dried and later treated with a lanolin cream. If liquid has entered the eyes they should be immediately flushed with lukewarm water for at least 15 minutes.

SECTION VI REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID Welding, open flames and infra red heaters.
	STABLE	X	

INCOMPATIBILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS Small amounts of HCl from thermal decomposition.

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Avoid breathing high concentrations of the vapors and avoid repeated contact of the liquid with the skin and clothing. Flush spilled areas with water.

Be sure sufficient fresh air enters the area or it should be vacated.

WASTE DISPOSAL METHOD Used solvent should be recovered by distillation. The residue from distillation may be incinerated, dry walled etc. Check local requirements.

SECTION VIII SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) None necessary when the perchloroethylene is used in a properly designed and operated degreaser or machine.

VENTILATION	LOCAL EXHAUST Sufficient to maintain TLV	SPECIAL During Clean-outs: Tanks are to be completely emptied and aired or flushed with water.
	MECHANICAL (Ceiling) Avoid drafts over or at degreasers	

PROTECTIVE GLOVES Normally not necessary (Neoprene) EYE PROTECTION Normally not necessary (glasses/goggles)

OTHER PROTECTIVE EQUIPMENT When cleaning tanks never enter until safe or use air respirator. Use buddy system

SECTION IX SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Avoid spillage and leak causing accidents.

OTHER PRECAUTIONS Avoid spillage, repeated contact with the skin and prolonged breathing of the vapors.

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INDUSTRIAL HYGIENE

*** PERCHLOR, PERCHLOROETHYLENE

MSDS NUMBER: 0041
DATE: 06/01/88
EDITION: 008
TRADE NAME: PERCHLOR, PERCHLOROETHYLENE
CHEMICAL NAME/SYNONYMS: TETRACHLOROETHYLENE
CHEMICAL FAMILY: HALOGENATED HYDROCARBON
FORMULA: $\text{CCL}_2=\text{CCL}_2$ CAS NUMBER: 00127 18 4
U.S. DOT SHIPPING NAME: PERCHLOROETHYLENE
U.S. DOT HAZARD CLASS: ORM-A
SUBSIDIARY RISK: N/A
I.D. NUMBER: UN1897
REPORTABLE QUANTITY: N/A

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SECTION 1 * PHYSICAL DATA

BOILING POINT @ 760 MM HG: 121 C
VAPOR DENSITY (AIR=1): 5.83
SPECIFIC GRAVITY (H₂O=1): 1.6 @ 20/20 C
PH OF SOLUTIONS: 6.8 TO 8.4
FREEZING/MELTING POINT: -22.3 C
SOLUBILITY (WEIGHT % IN WATER): 0.015% @ 25 C
BULK DENSITY: 13.6 LBS/GAL @ 20 C
VOLUME % VOLATILE: 100
VAPOR PRESSURE: 14.2 MM HG @ 20 C
EVAPORATION RATE: (ETHYL ETHER=1): 0.09
HEAT OF SOLUTION: N/A
APPEARANCE AND ODOR:
CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR.

SECTION 2 * INGREDIENTS

MATERIAL	PERCENT
PERCHLOROETHYLENE (STABILIZED)	> 99

SECTION 3 * FIRE/EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):
NONE

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FLAMMABLE LIMITS IN AIR (% BY VOLUME)

LEL: NONE

UEL: NONE

EXTINGUISHING MEDIA:

WATER, DRY CHEMICALS, OR CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:

FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA APPROVED PRESSURE DEMAND SELF-CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

PERCHLOR INVOLVED IN FIRES CAN DECOMPOSE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

SECTION 4 * HEALTH HAZARD DATA

TOXICITY DATA:

LC50 INHALATION:

(RAT) 4000 PPM (4 HOURS)

LD50 DERMAL:

NOT DETERMINED

SKIN/EYE IRRITATION:

SEE SECTION 5

LD50 INGESTION:

(RABBIT) 5000 MG/KG

FISH, LC50 (LETHAL CONCENTRATION): 96 HR TLM: 100-10 PPM

CLASSIFICATION: (POISON, IRRITANT, ETC.)

INHALATION: MODERATELY TOXIC

SKIN: NOT DETERMINED

SKIN/EYE: MILDLY IRRITATING / IRRITANT

INGESTION: SLIGHTLY TOXIC

AQUATIC: TOXIC

SECTION 5 * EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE.

IS CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?

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NTP - NO IARC - YES OSHA - NO

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:

PROLONGED EXPOSURE ABOVE THE OSHA PERMISSIBLE EXPOSURE LIMIT MAY COMPLICATE EXISTING LIVER AND KIDNEY DISEASES.

PERMISSIBLE EXPOSURE LIMITS:

OSHA: 100 PPM, 8-HOUR TIME WEIGHTED AVERAGE.
200 PPM, ACCEPTABLE CEILING CONCENTRATION.
300 PPM, ACCEPTABLE MAXIMUM PEAK ABOVE THE CEILING CONCENTRATION FOR AN 8-HOUR SHIFT. THE MAXIMUM DURATION FOR THIS EXPOSURE IS 5 MINUTES IN ANY 3 HOURS (29 CFR 1910.1000, TABLE Z-2).
ACGIH: 50 PPM, 8-HOUR TWA (TIME WEIGHTED AVERAGE);
200 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).
PPG INTERNAL PERMISSIBLE EXPOSURE LIMIT: 50 PPM, 8-HOUR TWA (TIME WEIGHTED AVERAGE); 100 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).

ACUTE:

INHALATION: PERCHLOROETHYLENE IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT AND CAN CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE WITH OVEREXPOSURE. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY TRACT, DIZZINESS, NAUSEA, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREA. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN AND IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT ALONG WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION. VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION.

CHRONIC:

PROLONGED EXPOSURE ABOVE THE OSHA PERMISSIBLE EXPOSURE LIMITS MAY RESULT IN LIVER AND KIDNEY DAMAGE. PERCHLOROETHYLENE HAS BEEN EXTENSIVELY STUDIED FOR ITS CANCER POTENTIAL. A RECENT NTP STUDY HAS DETERMINED THAT THERE IS CLEAR EVIDENCE OF CARCINOGENICITY (LIVER) IN BOTH MALE AND FEMALE MICE, CLEAR EVIDENCE OF LEUKEMIA IN MALE AND FEMALE RATS AND SOME EVIDENCE OF ANIMAL CARCINOGENICITY (KIDNEY TUMORS) IN MALE RATS. THE

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NTP STUDY EXPOSED RATS TO 200 AND 400 PPM AND MICE TO 100 AND 200 PPM IN A LIFETIME STUDY. PRUDENT HANDLING PRACTICES SHOULD BE FOLLOWED TO MINIMIZE HUMAN EXPOSURE.

PERCHLOROETHYLENE IS LISTED UNDER IARC AS A 2B.

* EMERGENCY AND FIRST AID PROCEDURES

INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:

FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:

IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):

NEVER ADMINISTER ADRENALINE FOLLOWING PERCHLOROETHYLENE OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALINE MAY BE CAUSED BY OVEREXPOSURE TO PERCHLOROETHYLENE.

SECTION 6 * REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID: OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR

CONDITIONS TO AVOID: NONE

INCOMPATIBILITY (MATERIALS TO AVOID):

NONE

HAZARDOUS DECOMPOSITION PRODUCTS:

HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE

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SECTION 7 * SPILL OR LEAK PROCEDURES**STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:**

IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ADSORBENTS, SUCH AS SAWDUST OR VERMICULITE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THOROUGHLY WET VACUUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

WASTE DISPOSAL METHOD:

CONTAMINATED SAWDUST, VERMICULITE, SOIL OR POROUS SURFACE MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE REPROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT, AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

SECTION 8 * SPECIAL PROTECTION INFORMATION**RESPIRATORY PROTECTION:**

USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILIARY SCBA OPERATED IN THE PRESSURE DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 29 CFR 1910.134.

VENTILATION(TYPE):

USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS.

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EYE PROTECTION:

SPLASHPROOF GOGGLES

GLOVES:

VITON(R), SILVER SHIELD(R).

FOR LIMITED SERVICE ONLY: NITRILE AND
POLYVINYL ALCOHOL (DEGRADES IN WATER).

OTHER PROTECTIVE EQUIPMENT:

BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT
SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE
IN ACCORDANCE WITH 29 CFR 1910.132 AND 29 CFR 1910.133.

SECTION 9 * SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:

- * **CANCER INFORMATION:** HAS CAUSED CANCER IN CERTAIN LABORATORY ANIMALS,
OF QUESTIONABLE RELEVANCE TO HUMANS.
- * **DO NOT USE** IN POORLY VENTILATED OR CONFINED SPACES WITHOUT PROPER
RESPIRATORY PROTECTION (SEE SECTION 8).
- * **PERCHLOROETHYLENE** VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW
AREAS.
- * **KEEP CONTAINER CLOSED** WHEN NOT IN USE.
- * **STORE ONLY** IN CLOSED, PROPERLY LABELED CONTAINERS.
- * **THIS MATERIAL** OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING
SURFACES OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE GAS
AND TRACES OF PHOSGENE.
- * **AVOID CONTAMINATION** OF WATER SUPPLIES. HANDLING, STORAGE AND USE
PROCEDURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY
SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION
WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT
FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY
CORRECTED.
- * **A CHLORINATED SOLVENT** USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN
SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER
THAN THE FLAMMABLE COMPONENT.
- * **DO NOT USE** CUTTING OR WELDING TORCHES ON DRUMS THAT CONTAINED PERCHLORO-
ETHYLENE UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

- * **DO NOT BREATHE** VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS,
UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE OR DEATH. LONG-
TERM OVEREXPOSURE MAY CAUSE LIVER/KIDNEY INJURY.

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- * USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO PERCHLOROETHYLENE BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE.
- * AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.
- * AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
- * DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
- * DO NOT EAT, DRINK, OR SMOKE IN WORK AREA.

COMMENTS:

TSCA - PERCHLOROETHYLENE IS LISTED ON THE TSCA INVENTORY UNDER CAS NO. 127-18-4.

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE, CHRONIC, B) LISTED IN SECTION 313 UNDER TETRACHLOROETHYLENE, C) LISTED IN SECTION 302 AS A HAZARDOUS SUBSTANCE WITH REPORTABLE QUANTITY OF 1# (PROPOSED RQ REVISION TO 100#'S).

RCRA - WASTE PERCHLOROETHYLENE AND CONTAMINATED SOILS/MATERIALS FROM SPILL CLEAN-UP ARE U210 HAZARDOUS WASTE AS PER 40 CFR 261.33 AND MUST BE DISPOSED OF ACCORDINGLY UNDER RCRA. SEE 40 CFR 261.33(C) AND 261.7(B)(3) FOR TRIPLE RINSING REQUIREMENTS FOR EMPTY DRUMS.

R. KENNETH LEE
MANAGER, PRODUCT SAFETY

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Vulcan CHEMICALS

Division of Vulcan Materials Company P.O. Box 7689 • Birmingham, AL 35253-0689

PMC 9056 MATERIAL SAFETY DATA SHEET

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24 Hour Emergency Phone (316) 524-5751

FEB 17 1988

I - IDENTIFICATION		INDUSTRIAL HYGIENE
CHEMICAL NAME 1,1,1 Trichloroethane	CHEMICAL FORMULA $C_2H_3Cl_3$	MOLECULAR WEIGHT 133.4
TRADE NAME Solvent 111 [®] , General Purpose Grade, Industrial Grade		
SYNONYMS Methyl Chloroform		DOT IDENTIFICATION NO UN 2831

II - PRODUCT AND COMPONENT DATA			
COMPONENT(S) CHEMICAL NAME 1,1,1 Trichloroethane Diethylene ether The hazard information presented is based on tests conducted on this or similar mixtures.	CAS REGISTRY NO. 71-55-6 123-91-1	% (Approx) 95.5	ACGIH TLV-TWA 350 ppm

III - PHYSICAL DATA	
APPEARANCE AND ODOR Clear, colorless liquid, slightly sweet odor	SPECIFIC GRAVITY 1.32 @ 25°/25°C
BOILING POINT 165°F (74°C)	VAPOR DENSITY IN AIR (Air = 1) 4.6
VAPOR PRESSURE 100 mm Hg @ 20°C	% VOLATILE BY VOLUME 100
EVAPORATION RATE (ether = 1): 0.4	SOLUBILITY IN WATER 0.07 gm/100 gm @ 25°C

IV - REACTIVITY DATA	
STABILITY Stable	CONDITIONS TO AVOID Avoid contact with open flame, electric arcs, or other hot surfaces which can cause thermal decomposition.
INCOMPATIBILITY (Materials to avoid) Strong alkalis, oxidizers, and reactive metals (i.e., aluminum, potassium, sodium, etc.). Refer to Section VIII for additional information on aluminum.	
HAZARDOUS DECOMPOSITION PRODUCTS Hydrogen chloride, phosgene, chlorine.	
HAZARDOUS POLYMERIZATION Will not occur.	

CHRONIC TOXICITY

PMC 9056

The finding of chronic toxic effects in laboratory animals may indicate toxicity to humans. Over-exposure should be avoided, failure to do so could result in injury, illness or even death.

Chronic overexposures to 1,1,1 trichloroethane have caused liver toxic effects in experimental animals.

Carcinogenicity - The available data indicates that 1,1,1 trichloroethane is not carcinogenic in laboratory animals.

1,1,1 trichloroethane is not listed on the OSHA, IARC, or NTP carcinogen lists.

Reproductive Toxicity - Three studies have been performed on laboratory animals to evaluate the effects of 1,1,1 trichloroethane on reproduction and fetal development. Two of the three studies indicate no reproductive toxicity. The third study noted delays in normal development, but these delays did not affect later life.

VII - PERSONAL PROTECTION AND CONTROLS

RESPIRATORY PROTECTION

Where vapor concentration exceeds or is likely to exceed 350 ppm, an approved organic vapor type respirator is acceptable. Approved self-contained breathing apparatus or air line respirator, with full face piece, is required for vapor concentrations above 1,000 ppm and for spills and/or emergencies. Follow any applicable respirator use standards or regulations.

VENTILATION

Do not use in closed or confined space. Open doors and/or windows. Use ventilation to maintain exposure levels below 350 ppm.

SKIN PROTECTION

Wear solvent-resistant gloves such as Viton, polyvinyl alcohol, or equivalent. Solvent-resistant boots, apron, headgear and/or faceshield should be worn where splashing is possible.

EYE PROTECTION

Wear safety glasses. Contact lenses should not be worn. Chemical goggles and/or face shields should be worn where splashing is possible.

HYGIENE

Avoid contact with skin and avoid breathing vapors. Do not eat, drink, or smoke in work area. Wash hands prior to eating, drinking, or using restroom.

OTHER CONTROL MEASURES

To determine exposure level(s), monitoring should be performed regularly. Safety shower and eyewash station should be available.

NOTE: Protective equipment and clothing should be selected, used, and maintained according to applicable standards and regulations. For further information, contact the clothing or equipment manufacturer or the Vulcan Chemicals Technical Service department.

Vulcan CHEMICALS

Division of Vulcan Materials Company P.O. Box 7889 • Birmingham, AL 35253-0889

PMC 9056 MATERIAL SAFETY DATA SHEET

RECEIVED
24 Hour Emergency Phone (316) 524-5751

FEB 17 1988

I - IDENTIFICATION		INDUSTRIAL HYGIENE
CHEMICAL NAME 1,1,1 Trichloroethane	CHEMICAL FORMULA $C_2H_3Cl_3$	MOLECULAR WEIGHT 133.4
TRADE NAME Solvent III®, General Purpose Grade, Industrial Grade		
SYNONYMS Methyl Chloroform		DOT IDENTIFICATION NO UN 2831

II - PRODUCT AND COMPONENT DATA			
COMPONENT(S) CHEMICAL NAME 1,1,1 Trichloroethane Diethylene ether The hazard information presented is based on tests conducted on this or similar mixtures.	CAS REGISTRY NO. 71-55-6 123-91-1	% (Approx) 95.5	ACGIH TLV-TWA 350 ppm

III - PHYSICAL DATA	
APPEARANCE AND ODOR Clear, colorless liquid, mildly sweet odor	SPECIFIC GRAVITY 1.32 @ 25°/25°C
BOILING POINT 165°F (74°C)	VAPOR DENSITY IN AIR (Air = 1) 4.6
VAPOR PRESSURE 100 mm Hg @ 20°C	% VOLATILE BY VOLUME 100
EVAPORATION RATE (ether = 1): 0.4	SOLUBILITY IN WATER 0.07 gm/100 gm @ 25°C

IV - REACTIVITY DATA	
STABILITY Stable	CONDITIONS TO AVOID Avoid contact with open flame, electric arcs, or other hot surfaces which can cause thermal decomposition.
INCOMPATIBILITY (Materials to avoid) Strong alkalis, oxidizers, and reactive metals (i.e., aluminum, potassium, sodium, etc.). Refer to Section VIII for additional information on aluminum.	
HAZARDOUS DECOMPOSITION PRODUCTS Hydrogen chloride, phosgene, chlorine.	
HAZARDOUS POLYMERIZATION Will not occur.	

V - FIRE AND EXPLOSION HAZARD DATA

PMC 9056

FLASH POINT (Method used)

None (TOC)

FLAMMABLE LIMITS IN AIR

7.5 - 15.0% (vol.) @ 25°C

EXTINGUISHING AGENTS

Water, foam, dry chemical, carbon dioxide (CO₂)

UNUSUAL FIRE AND EXPLOSION HAZARDS Concentrated vapors can be ignited by high intensity ignition sources.

Firefighters should wear self-contained, positive-pressure breathing apparatus, due to thermal decomposition products, and avoid skin contact.

VI - TOXICITY AND FIRST AID

EXPOSURE LIMITS (When exposure to this product and other chemicals is concurrent, the TLV must be defined in the workplace.)

1,1,1 trichloroethane ACGIH: 350 ppm TWA (8 hr), 450 ppm STEL

OSHA: 350 ppm TWA (8 hr)

(Odor threshold approximately 100 ppm; causes olfactory fatigue)

Effects described in this section are believed not to occur if exposures are maintained at or below appropriate TLVs.

Because of the wide variation in individual susceptibility, TLVs may not be applicable to all persons and those with medical conditions listed below.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE

Acute and chronic liver disease and rhythm disorders of the heart.

ACUTE TOXICITY

Primary route(s) of exposure:

☒ Inhalation

☐ Skin Absorption

☐ Ingestion

Inhalation: Major potential route of exposure. Minimal effects observed below 1,000 ppm; dizziness, drowsiness, and throat irritation at levels above 1,000 ppm. Unconsciousness and death possible at levels above 10,000 ppm. Blood pressure depression, cardiac sensitization, and ventricular arrhythmia can result from the exposure to near-anesthetic levels.

Skin: Prolonged or repeated skin contact can cause irritation, defatting of skin, and dermatitis. Absorption of liquid through intact skin possible, resulting in systemic effects, but unlikely route of significant exposure.

Eyes: Liquid can cause slight temporary irritation with slight temporary corneal injury. Vapors can irritate eyes.

Ingestion: Single dose toxicity is low to moderate. If vomiting occurs, 1,1,1 trichloroethane can be aspirated into the lungs, which can cause chemical pneumonia and systemic effects.

FIRST AID

Inhalation: Remove to fresh air. If breathing has stopped, administer artificial respiration. Call a physician.

Skin: Remove contaminated clothing and shoes. Wash exposed area with soap and water. Wash contaminated clothing before reuse.

Eyes: Flush eyes immediately with water for at least 15 minutes. If irritation persists, call a physician.

Ingestion: Do not induce vomiting. Contact physician or emergency medical facility immediately.

NOTE TO PHYSICIAN: Adrenalin should never be given to persons overexposed to 1,1,1 trichloroethane.



PMC 9056

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PITTSBURGH, PA 15272

*** TRI-ETHANE(R) 366

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MSDS NUMBER: 0086
DATE: 10/05/88
EDITION: 011
TRADE NAME: TRI-ETHANE(R) 366
CHEMICAL NAME/SYNONYMS: 1,1,1-TRICHLOROETHANE, METHYLCHLOROFORM
CHEMICAL FAMILY: HALOGENATED HYDROCARBONS
FORMULA: CH3CCl3
U.S. DOT SHIPPING NAME: 1,1,1-TRICHLOROETHANE
U.S. DOT HAZARD CLASS: ORM-A
SUBSIDIARY RISK: N/A
I.D. NUMBER: UN2831
REPORTABLE QUANTITY: 1000 LBS/454 KG
ONLY REGULATED WHEN SHIPPED IN BULK OR BY AIR.
* STABILIZED FOR VAPOR DEGREASING AND GENERAL SOLVENT USE.

CAS NUMBER: 00071 55 6

SECTION 1 * PHYSICAL DATA

BOILING POINT @ 760 MM HG: 72-88 C
VAPOR DENSITY (AIR=1): 4.54
SPECIFIC GRAVITY (H2O=1): 1.300-1.320 @ 25/25 C
PH OF SOLUTIONS: 6.0 TO 7.5
FREEZING/MELTING POINT: -45 C
SOLUBILITY (WEIGHT % IN WATER): NEGLIGIBLE
BULK DENSITY: 10.8-10.97 #/GAL @ 25 C
VOLUME % VOLATILE: 100
VAPOR PRESSURE: 135 MM HG @ 25 C
EVAPORATION RATE: (ETHYL ETHER=1): 0.35
HEAT OF SOLUTION: N/A
APPEARANCE AND ODOR:
CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR
NOTE: TESTED MIXTURE.

SECTION 2 * INGREDIENTS

MATERIAL	PERCENT
1,1,1-TRICHLOROETHANE (STABILIZED)	96
1,4-DIETHYLENE DIOXIDE (CAS #123-91-1), GLYCOL	BALANCE
METHYLENE ETHER (CAS #646-06-0), SEC BUTANOL (CAS #78-92-2), OTHER STABILIZERS. (TESTED MIXTURE)	

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* * TRI-ETHANE(R) 366

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SECTION 3 * FIRE/EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):

NONE

FLAMMABLE LIMITS IN AIR (% BY VOLUME)

LEL: 7%

UEL: 15%

EXTINGUISHING MEDIA:

WATER, DRY CHEMICALS OR CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:

FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA APPROVED, PRESSURE DEMAND, SELF-CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

VAPORS CONCENTRATED IN A CONFINED OR POORLY VENTILATED AREA CAN BE IGNITED UPON CONTACT WITH A HIGH ENERGY SPARK, FLAME, OR HIGH INTENSITY SOURCE OF HEAT. THIS CAN OCCUR AT CONCEN. RANGING BETWEEN 7-15% BY VOLUME. DECOMPOSITION OR BURNING CAN PRODUCE HYDROGEN CHLORIDE OR POSSIBLE TRACES OF PHOSGENE.

SECTION 4 * HEALTH HAZARD DATA

TOXICITY DATA:

LC50 INHALATION: (RAT) 14,250 PPM/7 HOURS

LD50 DERMAL: (RABBIT) > 15 G/KG

SKIN/EYE IRRITATION: SEE SECTION 5

LD50 INGESTION: (RAT) 10-12 G/KG

FISH, LC50 (LETHAL CONCENTRATION): UNKNOWN

CLASSIFICATION: (POISON, IRRITANT, ETC.)

INHALATION: SLIGHTLY TOXIC

SKIN: NOT SIGNIFICANTLY TOXIC

SKIN/EYE: IRRITATING

INGESTION: NOT SIGNIFICANTLY TOXIC

AQUATIC: UNKNOWN

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SECTION 5 * EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE.

IS CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?

NTP - NO IARC - NO OSHA - NO

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:

NONE KNOWN.

PERMISSIBLE EXPOSURE LIMITS:

OSHA: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 29 CFR 1910.1000.

ACGIH: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE);

450 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).

ACUTE:

INHALATION: TRI-ETHANE(R) IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY SYSTEM, DIZZINESS, NAUSEA, LIGHTEADEDNESS, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREAS. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.

AEROSOL - PRELIMINARY RESULTS FROM STUDIES IN RATS INDICATE THAT THE ACUTE INHALATION TOXICITY OF "AEROSOLIZED" 1,1,1-TRICHLOROETHANE IS HIGHER THAN EXPECTED BASED ON THE REPORTED ACUTE INHALATION TOXICITY OF 1,1,1-TRICHLOROETHANE VAPOR. THE SIGNIFICANCE OF THESE FINDINGS TO HUMAN HEALTH IN PRODUCT USE SITUATIONS IS NOT CLEARLY UNDERSTOOD.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN AND IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION.

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VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION. LD50 INGESTION (RABBIT; GUINEA PIG) 5.6-9.5 G/KG.

CHRONIC:

TRI-ETHANE(R) HAS BEEN EXTENSIVELY STUDIED FOR CANCER POTENTIAL. THERE IS NO DOCUMENTED EVIDENCE TO SUGGEST THAT TRI-ETHANE(R) CAUSES AN INCREASED CANCER INCIDENCE IN HUMANS OR ANIMALS. THE EPA'S SCIENCE ADVISORY BOARD CONCLUDED THAT THERE IS NO EVIDENCE TO SUGGEST CARCINOGENIC ACTIVITY FOR TRI-ETHANE(R).

REPRODUCTIVE:

IN DEVELOPMENTAL TOXICITY STUDIES, THERE WAS NO EVIDENCE FOR BIRTH DEFECTS IN RATS OR RABBITS AFTER INHALATION EXPOSURE TO PREGNANT ANIMALS. NO ADVERSE FINDINGS RELATIVE TO REPRODUCTIVE OR DEVELOPMENTAL TOXICITY WERE OBSERVED FOLLOWING DAILY SIX-HOUR EXPOSURES AT OR BELOW 3000 PPM IN RATS OR RABBITS.

*** EMERGENCY AND FIRST AID PROCEDURES**

INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:

FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:

IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):

NEVER ADMINISTER ADRENALINE FOLLOWING TRI-ETHANE(R) OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALINE MAY BE CAUSED BY OVEREXPOSURE TO TRI-ETHANE(R).

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SECTION 6 * REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID: OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

CONDITIONS TO AVOID: NONE

INCOMPATIBILITY (MATERIALS TO AVOID):

AVOID MIXING WITH CAUSTIC SODA, CAUSTIC POTASH, OR OXIDIZING MATERIALS. SHOCK SENSITIVE COMPOUNDS MAY BE FORMED.

HAZARDOUS DECOMPOSITION PRODUCTS:

HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

SECTION 7 * SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:

IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ADSORBENTS, SUCH AS SAWDUST AND VERMICULATE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THOROUGHLY WET VACUUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH CONTAMINATED EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

WASTE DISPOSAL METHOD:

CONTAMINATED SAWDUST, VERMICULITE, OR POROUS SURFACES MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE REPROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT, AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

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SECTION 8 * SPECIAL PROTECTION INFORMATION**RESPIRATORY PROTECTION:**

USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILIARY SCBA OPERATED IN THE PRESSURE-DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 29 CFR 1910.134.

VENTILATION(TYPE):

USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS.

EYE PROTECTION:

SPLASHPROOF GOGGLES

GLOVES:

VITRON(R), SILVER SHIELD(R), FOR LIMITED SERVICE ONLY: POLYVINYL ALCOHOL (DEGRADES IN WATER)

OTHER PROTECTIVE EQUIPMENT:

BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29 CFR 1910.132 AND 29 CFR 1910.133.

SECTION 9 * SPECIAL PRECAUTIONS**PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:**

- * DO NOT USE IN POORLY VENTILATED OR CONFINED AREAS WITHOUT PROPER RESPIRATORY PROTECTION (SEE SECTION 8).
- * TRI-ETHANE(R) VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
- * KEEP CONTAINER CLOSED WHEN NOT IN USE.
- * STORE ONLY IN CLOSED, PROPERLY LABELED CONTAINERS.
- * LIQUID OXYGEN OR OTHER STRONG OXIDANTS MAY FORM EXPLOSIVE MIXTURES WITH TRI-ETHANE(R).
- * THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES, OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.
- * AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE, AND USE PROC-



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* * TRI-ETHANE(R) 366

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DURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY CORRECTED.

- * DO NOT STORE OR STACK ALUMINUM IN CONTACT WITH TRI-ETHANE(R) TO PREVENT POSSIBLE SOLVENT DECOMPOSITION (STACKING CORROSION).
- * CAUTION SHOULD BE TAKEN NOT TO USE IN PRESSURIZED OR TOTALLY ENCLOSED SYSTEM OF ALUMINUM CONSTRUCTION. EXAMPLE: PAINT OR ADHESIVE SPRAY SYSTEM.
- * A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
- * DO NOT USE CUTTING OR WELDING TORCHES ON EMPTY DRUMS THAT CONTAINED TRI-ETHANE(R) UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

- * DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE.
- * USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO TRI-ETHANE(R) BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE. EYE IRRITATION, DIZZINESS AND/OR DRUNKENNESS ARE SIGNS OF OVEREXPOSURE.
- * AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.
- * AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
- * DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
- * DO NOT EAT, DRINK OR SMOKE IN WORK AREA.

COMMENTS:

TSCA - 1,1,1-TRICHLOROETHANE IS ON THE TSCA INVENTORY UNDER CAS #71-55-6. TRI-ETHANE FORMULATIONS CONTAIN STABILIZERS THAT ARE LISTED ON THE TSCA INVENTORY.

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE, B) LISTED IN SECTION 313 AS 1,1,1-TRICHLOROETHANE (METHYLCHLOROFORM), C) NOT LISTED AS AN "EXTREMELY HAZARDOUS SUBSTANCE" IN SECTION 302.

CERCLA - LISTED IN TABLE 302.4 OF 40 CFR PART 302 AS A HAZARDOUS SUBSTANCE WITH A REPORTABLE QUANTITY OF 1000 POUNDS. RELEASES TO AIR, LAND, OR WATER WHICH EXCEED THE RQ MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.

RCRA - WASTE 1,1,1-TRICHLOROETHANE AND CONTAMINATED SOILS/MATERIALS FROM SPILL CLEANUP ARE U226 HAZARDOUS WASTE AS PER 40 CFR 261.33 AND MUST BE

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* * TRI-ETHANE(R) 366

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DISPOSED OF ACCORDINGLY UNDER RCRA. SEE 40 CFR 261.33(C) AND 261.7(B)(3)
FOR CLEANING REQUIREMENTS FOR EMPTY CONTAINERS.

CALIFORNIA PROP. 65 - THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE
OF CALIFORNIA TO CAUSE CANCER.

R. KENNETH LEE
MANAGER, PRODUCT SAFETY

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FORM 6372 Rev. 3-88

Material Safety Data Sheet



PM 09056

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PITTSBURGH, PA 15272

MSDS: 86 PRODUCT: TRI-ETHANE(R) 366

11/18/88

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INDUSTRIAL HYGIENE

PRATT & WHITNEY AIRCRAFT GROUP

MIDDLETOWN , CT 06457

GENTLEMEN:

AS YOU KNOW, YOU ARE CURRENTLY PURCHASING THE ABOVE-MENTIONED PRODUCT FROM PPG. EVEN THOUGH THIS PRODUCT IS VERY USEFUL, YOU SHOULD BE AWARE OF THE HAZARDS, PROPER HANDLING, AND USE OF SUCH PRODUCTS. ACCORDINGLY, WE ARE ENCLOSING THE ABOVE MATERIAL SAFETY DATA SHEET SHOWING WARNINGS AND INFORMATIONAL DATA.

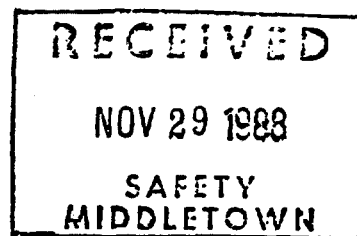
PPG URGES YOU, AND IT IS YOUR DUTY, TO PASS THE ENCLOSED WARNINGS AND INFORMATION ALONG TO YOUR EMPLOYEES, CUSTOMERS, HANDLERS, OR USERS OF THIS PRODUCT. THE SAME PRINCIPLE APPLIES TO ANY PRODUCT MADE BY YOU FROM PPG PRODUCTS.

EVEN THOUGH PPG IS FURNISHING THIS INFORMATION TO YOU, IT IS NOT NECESSARILY ALL-ENCOMPASSING; THEREFORE, IT IS RECOMMENDED THAT YOU SHOULD CONSULT WITH KNOWLEDGEABLE PEOPLE OF YOUR CHOICE IN ORDER TO DETERMINE WHETHER YOUR SAFETY PROGRAMS AND WARNINGS ARE ADEQUATE AND/OR IN COMPLIANCE WITH ANY APPLICABLE LAWS OR REGULATIONS.

VERY TRULY YOURS,

R. KENNETH LEE
MANAGER, PRODUCT SAFETY
ENVIRONMENTAL AFFAIRS
CHEMICALS

ENCLOSURE



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*** TRI-ETHANE(R) 366

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INDUSTRIAL HYGIENE

MSDS NUMBER: 0086
DATE: 10/05/88
EDITION: 011
TRADE NAME: TRI-ETHANE(R) 366
CHEMICAL NAME/SYNONYMS: 1,1,1-TRICHLOROETHANE, METHYLCHLOROFORM
CHEMICAL FAMILY: HALOGENATED HYDROCARBONS
FORMULA: CH₃CCl₃
U.S. DOT SHIPPING NAME: 1,1,1-TRICHLOROETHANE
U.S. DOT HAZARD CLASS: ORM-A
SUBSIDIARY RISK: N/A
I.D. NUMBER: UN2831
REPORTABLE QUANTITY: 1000 LBS/454 KG

CAS NUMBER: 00071 55 6

ONLY REGULATED WHEN SHIPPED IN BULK OR BY AIR.

* STABILIZED FOR VAPOR DEGREASING AND GENERAL SOLVENT USE.

SECTION 1 * PHYSICAL DATA

BOILING POINT @ 760 MM HG: 72-88 C
VAPOR DENSITY (AIR=1): 4.54
SPECIFIC GRAVITY (H₂O=1): 1.300-1.320 @ 25/25 C
PH OF SOLUTIONS: 6.0 TO 7.5
FREEZING/MELTING POINT: -45 C
SOLUBILITY (WEIGHT % IN WATER): NEGLIGIBLE
BULK DENSITY: 10.8-10.97 #/GAL @ 25 C
VOLUME % VOLATILE: 100
VAPOR PRESSURE: 135 MM HG @ 25 C
EVAPORATION RATE: (ETHYL ETHER=1): 0.35
HEAT OF SOLUTION: N/A
APPEARANCE AND ODOR:

CLEAR, COLORLESS LIQUID WITH ETHER-LIKE ODOR

NOTE: TESTED MIXTURE.

SECTION 2 * INGREDIENTS

MATERIAL	PERCENT
1,1,1-TRICHLOROETHANE (STABILIZED)	96
1,4-DIETHYLENE DIOXIDE (CAS #123-91-1), GLYCOL	BALANCE
METHYLENE ETHER (CAS #646-06-0), SEC BUTANOL (CAS #78-92-2), OTHER STABILIZERS. (TESTED MIXTURE)	

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SECTION 3 * FIRE/EXPLOSION HAZARD DATA

FLASH POINT (METHOD USED):

NONE

FLAMMABLE LIMITS IN AIR (% BY VOLUME)

LEL: 7%

UEL: 15%

EXTINGUISHING MEDIA:

WATER, DRY CHEMICALS OR CARBON DIOXIDE

SPECIAL FIRE FIGHTING PROCEDURES:

FIRE FIGHTERS SHOULD WEAR NIOSH/MSHA APPROVED, PRESSURE DEMAND, SELF-CONTAINED BREATHING APPARATUS FOR POSSIBLE EXPOSURE TO HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

VAPORS CONCENTRATED IN A CONFINED OR POORLY VENTILATED AREA CAN BE IGNITED UPON CONTACT WITH A HIGH ENERGY SPARK, FLAME, OR HIGH INTENSITY SOURCE OF HEAT. THIS CAN OCCUR AT CONCEN. RANGING BETWEEN 7-15% BY VOLUME. DECOMPOSITION OR BURNING CAN PRODUCE HYDROGEN CHLORIDE OR POSSIBLE TRACES OF PHOSGENE.

SECTION 4 * HEALTH HAZARD DATA

TOXICITY DATA:

LC50 INHALATION: (RAT) 14,250 PPM/7 HOURS

LD50 DERMAL: (RABBIT) > 15 G/KG

SKIN/EYE IRRITATION: SEE SECTION 5

LD50 INGESTION: (RAT) 10-12 G/KG

FISH, LC50 (LETHAL CONCENTRATION): UNKNOWN

CLASSIFICATION: (POISON, IRRITANT, ETC.)

INHALATION: SLIGHTLY TOXIC

SKIN: NOT SIGNIFICANTLY TOXIC

SKIN/EYE: IRRITATING

INGESTION: NOT SIGNIFICANTLY TOXIC

AQUATIC: UNKNOWN

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SECTION 5 * EFFECTS OF OVEREXPOSURE

THIS SECTION COVERS EFFECTS OF OVEREXPOSURE FOR INHALATION, EYE/SKIN CONTACT, INGESTION AND OTHER TYPES OF OVEREXPOSURE INFORMATION IN THE ORDER OF THE MOST HAZARDOUS AND THE MOST LIKELY ROUTE OF OVEREXPOSURE.

IS CHEMICAL LISTED AS A CARCINOGEN OR POTENTIAL CARCINOGEN?

NTP - NO IARC - NO OSHA - NO

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE:

NONE KNOWN.

PERMISSIBLE EXPOSURE LIMITS:

OSHA: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE); 29 CFR 1910.1000.

ACGIH: 350 PPM, 8-HOUR TWA (TIME-WEIGHTED AVERAGE);
450 PPM, STEL (SHORT-TERM EXPOSURE LIMIT).

ACUTE:

INHALATION: TRI-ETHANE(R) IS PRIMARILY A CENTRAL NERVOUS SYSTEM DEPRESSANT. INHALATION CAN CAUSE IRRITATION OF THE RESPIRATORY SYSTEM, DIZZINESS, NAUSEA, LIGHTHEADEDNESS, HEADACHE, LOSS OF COORDINATION AND EQUILIBRIUM, UNCONSCIOUSNESS, POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE AND EVEN DEATH IN CONFINED OR POORLY VENTILATED AREAS. FATALITIES FOLLOWING SEVERE ACUTE EXPOSURE TO VARIOUS CHLORINATED SOLVENTS HAVE BEEN ATTRIBUTED TO VENTRICULAR FIBRILLATION.

AEROSOL - PRELIMINARY RESULTS FROM STUDIES IN RATS INDICATE THAT THE ACUTE INHALATION TOXICITY OF "AEROSOLIZED" 1,1,1-TRICHLOROETHANE IS HIGHER THAN EXPECTED BASED ON THE REPORTED ACUTE INHALATION TOXICITY OF 1,1,1-TRICHLOROETHANE VAPOR. THE SIGNIFICANCE OF THESE FINDINGS TO HUMAN HEALTH IN PRODUCT USE SITUATIONS IS NOT CLEARLY UNDERSTOOD.

EYE/SKIN: LIQUID SPLASHED IN THE EYE CAN RESULT IN DISCOMFORT, PAIN AND IRRITATION. PROLONGED OR REPEATED CONTACT WITH LIQUID ON THE SKIN CAN CAUSE IRRITATION AND DERMATITIS. THE PROBLEM MAY BE ACCENTUATED BY LIQUID BECOMING TRAPPED AGAINST THE SKIN BY CONTAMINATED CLOTHING AND SHOES, AND SKIN ABSORPTION CAN OCCUR.

INGESTION: SWALLOWING OF THIS MATERIAL MAY RESULT IN IRRITATION OF THE MOUTH AND GI TRACT WITH OTHER EFFECTS AS LISTED ABOVE FOR INHALATION.

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VOMITING AND SUBSEQUENT ASPIRATION INTO THE LUNGS MAY LEAD TO CHEMICAL PNEUMONIA AND PULMONARY EDEMA WHICH IS A POTENTIALLY FATAL CONDITION. LD50 INGESTION (RABBIT; GUINEA PIG) 5.6-9.5 G/KG.

CHRONIC:

TRI-ETHANE(R) HAS BEEN EXTENSIVELY STUDIED FOR CANCER POTENTIAL. THERE IS NO DOCUMENTED EVIDENCE TO SUGGEST THAT TRI-ETHANE(R) CAUSES AN INCREASED CANCER INCIDENCE IN HUMANS OR ANIMALS. THE EPA'S SCIENCE ADVISORY BOARD CONCLUDED THAT THERE IS NO EVIDENCE TO SUGGEST CARCINOGENIC ACTIVITY FOR TRI-ETHANE(R).

REPRODUCTIVE:

IN DEVELOPMENTAL TOXICITY STUDIES, THERE WAS NO EVIDENCE FOR BIRTH DEFECTS IN RATS OR RABBITS AFTER INHALATION EXPOSURE TO PREGNANT ANIMALS. NO ADVERSE FINDINGS RELATIVE TO REPRODUCTIVE OR DEVELOPMENTAL TOXICITY WERE OBSERVED FOLLOWING DAILY SIX-HOUR EXPOSURES AT OR BELOW 3000 PPM IN RATS OR RABBITS.

*** EMERGENCY AND FIRST AID PROCEDURES**

INHALATION:

REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN.

EYE OR SKIN CONTACT:

FLUSH EYES AND SKIN WITH PLENTY OF WATER (SOAP AND WATER FOR SKIN) FOR AT LEAST 15 MINUTES, WHILE REMOVING CONTAMINATED CLOTHING AND SHOES. IF IRRITATION OCCURS, CONSULT A PHYSICIAN. THOROUGHLY CLEAN CONTAMINATED CLOTHING AND SHOES BEFORE REUSE OR DISCARD.

INGESTION:

IF CONSCIOUS, DRINK LARGE QUANTITIES OF WATER. DO NOT INDUCE VOMITING. TAKE IMMEDIATELY TO A HOSPITAL OR PHYSICIAN. IF UNCONSCIOUS, OR IN CONVULSIONS, TAKE IMMEDIATELY TO A HOSPITAL. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTES TO PHYSICIAN (INCLUDING ANTIDOTES):

NEVER ADMINISTER ADRENALINE FOLLOWING TRI-ETHANE(R) OVEREXPOSURE. INCREASED SENSITIVITY OF THE HEART TO ADRENALINE MAY BE CAUSED BY OVEREXPOSURE TO TRI-ETHANE(R).

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SECTION 6 * REACTIVITY DATA

STABILITY: STABLE

CONDITIONS TO AVOID: OPEN FLAMES, HOT GLOWING SURFACES OR ELECTRIC ARCS.

HAZARDOUS POLYMERIZATION: WILL NOT OCCUR.

CONDITIONS TO AVOID: NONE

INCOMPATIBILITY (MATERIALS TO AVOID):

AVOID MIXING WITH CAUSTIC SODA, CAUSTIC POTASH, OR OXIDIZING MATERIALS. SHOCK SENSITIVE COMPOUNDS MAY BE FORMED.

HAZARDOUS DECOMPOSITION PRODUCTS:

HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.

SECTION 7 * SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS SPILLED OR RELEASED:

IMMEDIATELY EVACUATE THE AREA AND PROVIDE MAXIMUM VENTILATION. UNPROTECTED PERSONNEL SHOULD MOVE UPWIND OF SPILL. ONLY PERSONNEL EQUIPPED WITH PROPER RESPIRATORY AND SKIN/EYE PROTECTION (SEE SECTION 8) SHOULD BE PERMITTED IN AREA. DIKE AREA TO CONTAIN SPILL. TAKE PRECAUTIONS AS NECESSARY TO PREVENT CONTAMINATION OF GROUND AND SURFACE WATERS. RECOVER SPILLED MATERIAL ON ADSORBENTS, SUCH AS SAWDUST AND VERMICULATE, AND SWEEP INTO CLOSED CONTAINERS FOR DISPOSAL. AFTER ALL VISIBLE TRACES, INCLUDING IGNITABLE VAPORS, HAVE BEEN REMOVED, THOROUGHLY WET VACUUM THE AREA. DO NOT FLUSH TO SEWER. IF AREA OF SPILL IS POROUS, REMOVE AS MUCH CONTAMINATED EARTH AND GRAVEL, ETC. AS NECESSARY AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

WASTE DISPOSAL METHOD:

CONTAMINATED SAWDUST, VERMICULITE, OR POROUS SURFACES MUST BE DISPOSED OF IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. RECOVERED LIQUIDS MAY BE REPROCESSED OR INCINERATED OR MUST BE TREATED IN A PERMITTED HAZARDOUS WASTE MANAGEMENT FACILITY. CARE MUST BE TAKEN WHEN USING OR DISPOSING OF CHEMICAL MATERIALS AND/OR THEIR CONTAINERS TO PREVENT ENVIRONMENTAL CONTAMINATION. IT IS YOUR DUTY TO DISPOSE OF THE CHEMICAL MATERIALS AND/OR THEIR CONTAINERS IN ACCORDANCE WITH THE CLEAN AIR ACT, THE CLEAN WATER ACT, THE RESOURCE CONSERVATION AND RECOVERY ACT, AS WELL AS ANY OTHER RELEVANT FEDERAL, STATE, OR LOCAL LAWS/REGULATIONS REGARDING DISPOSAL.

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SECTION 8 * SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION:

USE A HALF OR FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE OR CANISTER RESPIRATOR WHEN CONCENTRATIONS EXCEED PERMISSIBLE LIMITS. USE SELF-CONTAINED BREATHING APPARATUS (SCBA) OR FULL FACEPIECE AIRLINE RESPIRATOR WITH AUXILIARY SCBA OPERATED IN THE PRESSURE-DEMAND MODE FOR EMERGENCIES AND FOR ALL WORK PERFORMED IN STORAGE VESSELS, POORLY VENTILATED ROOMS, AND OTHER CONFINED AREAS. RESPIRATORS MUST BE APPROVED BY NIOSH OR MSHA. THE RESPIRATOR USE LIMITATIONS MADE BY NIOSH/MSHA AND BY THE MANUFACTURER MUST BE OBSERVED. RESPIRATORY PROTECTION PROGRAMS MUST BE IN ACCORDANCE WITH 29 CFR 1910.134.

VENTILATION(TYPE):

USE LOCAL EXHAUST OR DILUTION VENTILATION AS APPROPRIATE TO CONTROL EXPOSURES TO BELOW PERMISSIBLE LIMITS.

EYE PROTECTION:

SPLASHPROOF GOGGLES

GLOVES:

VITRON(R), SILVER SHIELD(R), FOR LIMITED SERVICE
ONLY: POLYVINYL ALCOHOL (DEGRADES IN WATER)

OTHER PROTECTIVE EQUIPMENT:

BOOTS, APRONS, OR CHEMICAL SUITS SHOULD BE USED WHEN NECESSARY TO PREVENT SKIN CONTACT. PERSONAL PROTECTIVE CLOTHING AND USE OF EQUIPMENT MUST BE IN ACCORDANCE WITH 29 CFR 1910.132 AND 29 CFR 1910.133.

SECTION 9 * SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN DURING HANDLING AND STORING:

- * DO NOT USE IN POORLY VENTILATED OR CONFINED AREAS WITHOUT PROPER RESPIRATORY PROTECTION (SEE SECTION 8).
- * TRI-ETHANE(R) VAPORS ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS.
- * KEEP CONTAINER CLOSED WHEN NOT IN USE.
- * STORE ONLY IN CLOSED, PROPERLY LABELED CONTAINERS.
- * LIQUID OXYGEN OR OTHER STRONG OXIDANTS MAY FORM EXPLOSIVE MIXTURES WITH TRI-ETHANE(R).
- * THIS MATERIAL OR ITS VAPORS WHEN IN CONTACT WITH FLAMES, HOT GLOWING SURFACES, OR ELECTRIC ARCS CAN DECOMPOSE TO FORM HYDROGEN CHLORIDE AND POSSIBLE TRACES OF PHOSGENE.
- * AVOID CONTAMINATION OF WATER SUPPLIES. HANDLING, STORAGE, AND USE PROC-

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- DURES MUST BE CAREFULLY MONITORED TO AVOID SPILLS OR LEAKS. ANY SPILL OR LEAK HAS THE POTENTIAL TO CAUSE UNDERGROUND WATER CONTAMINATION WHICH MAY, IF SUFFICIENTLY SEVERE, RENDER A DRINKING WATER SOURCE UNFIT FOR HUMAN CONSUMPTION. CONTAMINATION THAT DOES OCCUR CANNOT BE EASILY CORRECTED.
- * DO NOT STORE OR STACK ALUMINUM IN CONTACT WITH TRI-ETHANE(R) TO PREVENT POSSIBLE SOLVENT DECOMPOSITION (STACKING CORROSION).
 - * CAUTION SHOULD BE TAKEN NOT TO USE IN PRESSURIZED OR TOTALLY ENCLOSED SYSTEM OF ALUMINUM CONSTRUCTION. EXAMPLE: PAINT OR ADHESIVE SPRAY SYSTEM.
 - * A CHLORINATED SOLVENT USED AS A FLASHPOINT SUPPRESSANT MUST BE ADDED IN SUFFICIENT QUANTITY OR THE RESULTANT MIXTURE MAY HAVE A FLASHPOINT LOWER THAN THE FLAMMABLE COMPONENT.
 - * DO NOT USE CUTTING OR WELDING TORCHES ON EMPTY DRUMS THAT CONTAINED TRI-ETHANE(R) UNLESS PROPERLY PURGED AND CLEANED.

OTHER PRECAUTIONS:

- * DO NOT BREATHE VAPORS. HIGH VAPOR CONCENTRATIONS CAN CAUSE DIZZINESS, UNCONSCIOUSNESS OR DEATH. LONG-TERM OVEREXPOSURE MAY CAUSE POSSIBLE CENTRAL NERVOUS SYSTEM DAMAGE.
- * USE ONLY WITH ADEQUATE VENTILATION. VENTILATION MUST BE SUFFICIENT TO LIMIT EMPLOYEE EXPOSURE TO TRI-ETHANE(R) BELOW PERMISSIBLE EXPOSURE LIMITS. OBSERVANCE OF LOWER LIMITS (OUTLINED IN SECTION 5) IS ADVISABLE. EYE IRRITATION, DIZZINESS AND/OR DRUNKENNESS ARE SIGNS OF OVEREXPOSURE.
- * AVOID CONTACT WITH EYES. WILL CAUSE IRRITATION AND PAIN.
- * AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. MAY CAUSE IRRITATION OR DERMATITIS.
- * DO NOT SWALLOW. SWALLOWING MAY CAUSE INJURY OR DEATH.
- * DO NOT EAT, DRINK OR SMOKE IN WORK AREA.

COMMENTS:

TSCA - 1,1,1-TRICHLOROETHANE IS ON THE TSCA INVENTORY UNDER CAS #71-55-6. TRI-ETHANE FORMULATIONS CONTAIN STABILIZERS THAT ARE LISTED ON THE TSCA INVENTORY.

SARA TITLE III - A) 311/312 CATEGORIES - ACUTE, B) LISTED IN SECTION 313 AS 1,1,1-TRICHLOROETHANE (METHYLCHLOROFORM), C) NOT LISTED AS AN "EXTREMELY HAZARDOUS SUBSTANCE" IN SECTION 302.

CERCLA - LISTED IN TABLE 302.4 OF 40 CFR PART 302 AS A HAZARDOUS SUBSTANCE WITH A REPORTABLE QUANTITY OF 1000 POUNDS. RELEASES TO AIR, LAND, OR WATER WHICH EXCEED THE RQ MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER, 800-424-8802.

RCRA - WASTE 1,1,1-TRICHLOROETHANE AND CONTAMINATED SOILS/MATERIALS FROM SPILL CLEANUP ARE U226 HAZARDOUS WASTE AS PER 40 CFR 261.33 AND MUST BE

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DISPOSED OF ACCORDINGLY UNDER RCRA. SEE 40 CFR 261.33(C) AND 261.7(B)(3)
FOR CLEANING REQUIREMENTS FOR EMPTY CONTAINERS.

CALIFORNIA PROP. 65 - THIS PRODUCT CONTAINS A CHEMICAL KNOWN TO THE STATE
OF CALIFORNIA TO CAUSE CANCER.

R. KENNETH LEE
MANAGER, PRODUCT SAFETY

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MATERIAL SAFETY
DATA SHEET

Ashland Chemical Company

DIVISION OF ASHLAND OIL INC.

P O. BOX 2219, COLUMBUS, OHIO 43216 • (614) 889-3333

24-HOUR EMERGENCY TELEPHONE (606) 324-1133

RECEIVED Ashland.

NOV 18 1985

804681

TRICHLOROETHANE 111 DEGREES COLD/V

INDUSTRIAL HYGIENE PAGE: 1

THIS MSDS COMPLIES WITH 29 CFR 1910.1200 (THE HAZARD COMMUNICATION STANDARD)

PRODUCT NAME: TRICHLOROETHANE 111 DEGREES COLD/V
CAS NUMBER: 71 55 6PRATT AND WHITNEY
400 MAIN STREET
EAST HARTFORD

GT 06108

08 50 077 7228590-
DATA SHEET NO: 0001466-008
LATEST REVISION DATE: 10/85-85303
PRODUCT: 3948500
INVOICE: 884624
INVOICE DATE: 09/18/85
TO: PRATT AND WHITNEY
8801 MACON ROAD
COLUMBUS GA 31908

UTCIHL 19

ATTN: PLANT MGR./SAFETY DIR.

SECTION I-PRODUCT IDENTIFICATION

GENERAL OR GENERIC ID: CHLORINATED HYDROCARBON

HAZARD CLASSIFICATION: (14) ORM-A

SECTION II-HAZARDOUS COMPONENTS

INGREDIENT	% (BY WT)	PEL	TLV	NOTE
1,1,1-TRICHLOROETHANE	90-95	350	350 PPM	

SECTION III-PHYSICAL DATA

PROPERTY	REFINEMENT	MEASUREMENT
INITIAL BOILING POINT	FOR PRODUCT	161.00 - 190.40 DEG F (72.00 - 88.00 DEG C) 760.00 MMHG
VAPOR PRESSURE	FOR PRODUCT	100.00 MMHG 68.00 DEG F 20.00 DEG C
VAPOR DENSITY	AIR = 1	4.5
SPECIFIC GRAVITY		1.380 - 1.324 (77.00 DEG F 25.00 DEG C)
PERCENT VOLATILES		100.00%
EVAPORATION RATE	(ETHYL ETHER = 1)	2.60
APPEARANCE		CLEAR, APHA COLOR 15 MAX
STATE		LIQUID
FORM		HOMOGENEOUS SOLN

SECTION IV-FIRE AND EXPLOSION DATA

FLASH POINT NOT APPLICABLE

EXPLOSIVE LIMIT (PRODUCT)

LOWER - 6.7%

EXTINGUISHING MEDIA: WATER FOG

HAZARDOUS DECOMPOSITION PRODUCTS: MAY FORM TOXIC MATERIALS, CARBON DIOXIDE AND CARBON MONOXIDE, HYDROGEN CHLORIDE, PHOSGENE, VARIOUS HYDROCARBONS, ETC.

SPECIAL FIREFIGHTING PROCEDURES: WATER MAY BE USED TO KEEP FIRE-EXPOSED CONTAINERS COOL UNTIL FIRE IS OUT.

WEAR SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE WHEN FIGHTING FIRES.
UNUSUAL FIRE & EXPLOSION HAZARDS: NEVER USE WELDING OR CUTTING TORCH ON OR NEAR DRUM (EVEN EMPTY) BECAUSE PRODUCT (EVEN JUST RESIDUE) CAN IGNITE EXPLOSIVELY.

NFPA CODES:

HEALTH- 2

FLAMMABILITY- 1

REACTIVITY- 0

SECTION V-HEALTH HAZARD DATA

PERMISSIBLE EXPOSURE LEVEL 350 PPM

THRESHOLD LIMIT VALUE 350 PPM

EFFECTS OF OVEREXPOSURE: FOR PRODUCT

EYES - CAN CAUSE SEVERE IRRITATION, REDNESS, TEARING, BLURRED VISION.
SKIN - PROLONGED OR REPEATED CONTACT CAN CAUSE MODERATE IRRITATION, DEFATTING, DERMATITIS.
BREATHING - EXCESSIVE INHALATION OF VAPORS CAN CAUSE NASAL AND RESPIRATORY IRRITATION, DIZZINESS, WEAKNESS, FATIGUE, NAUSEA, HEADACHE, POSSIBLE UNCONSCIOUSNESS, AND EVEN ASPHYXIATION.
SWALLOWING - CAN CAUSE GASTROINTESTINAL IRRITATION, NAUSEA, VOMITING, AND DIARRHEA.

72-62-7820-01
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PMC 9058

004681

TRICHLOROETHAN 111 DEGREES COLD/V

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SECTION V-HEALTH HAZARD DATA (CONTINUED)

FIRST AID:

IF ON SKIN: THOROUGHLY WASH EXPOSED AREA WITH SOAP AND WATER. REMOVE CONTAMINATED CLOTHING. LAUNDRY CONTAMINATED CLOTHING BEFORE RE-USE.
IF IN EYES: FLUSH WITH LARGE AMOUNTS OF WATER, LIFTING UPPER AND LOWER LIDS OCCASIONALLY, GET MEDICAL ATTENTION.
IF SWALLOWED: DO NOT INDUCE VOMITING. CALL PHYSICIAN OR TRANSPORT TO AN EMERGENCY FACILITY.
IF BREATHED: IF AFFECTED, REMOVE INDIVIDUAL TO FRESH AIR. IF BREATHING IS DIFFICULT, ADMINISTER OXYGEN. IF BREATHING HAS STOPPED GIVE ARTIFICIAL RESPIRATION. KEEP PERSON WARM, QUIET AND GET MEDICAL ATTENTION. DO NOT GIVE STIMULANTS. EPINEPHRINE OR EPHEDRINE MAY ADVERSELY AFFECT THE HEART WITH FATAL RESULTS.

UTCHILQ

PRIMARY ROUTE(S) OF ENTRY:

INHALATION
SKIN CONTACT

SECTION VI-REACTIVITY DATA

HAZARDOUS POLYMERIZATION: CANNOT OCCUR

STABILITY: STABLE

INCOMPATIBILITY: AVOID CONTACT WITH: WATER, REACTIVE METALS SUCH AS ALUMINUM AND MAGNESIUM, OPEN FLAME, WELDING ARCS, RESISTANCE HEATERS, ETC., WHICH CAN RESULT IN THERMAL DECOMPOSITION RELEASING HYDROGEN CHLORIDE AND SMALL AMOUNTS OF PHOSGENE AND CHLORINE. STRONG OXIDIZING AGENTS.

SECTION VII-SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED:

SMALL SPILL: ABSORB LIQUID ON PAPER, VERMICULITE, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND TRANSFER TO HOOD.

LARGE SPILL: PERSONS NOT WEARING PROTECTIVE EQUIPMENT SHOULD BE EXCLUDED FROM AREA OF SPILL UNTIL CLEAN-UP HAS BEEN COMPLETED. STOP SPILL AT SOURCE, DIKE AREA OF SPILL TO PREVENT SPREADING. PUMP LIQUID TO SALVAGE TANK. REMAINING LIQUID MAY BE TAKEN UP ON SAND, CLAY, EARTH, FLOOR ABSORBENT, OR OTHER ABSORBENT MATERIAL AND SHOVELED INTO CONTAINERS.

WASTE DISPOSAL METHOD:

SMALL SPILL: ALLOW VOLATILE PORTION TO EVAPORATE IN HOOD. ALLOW SUFFICIENT TIME FOR VAPORS TO COMPLETELY CLEAR HOOD DUCT WORK. DISPOSE OF REMAINING MATERIAL IN ACCORDANCE WITH APPLICABLE REGULATIONS.

LARGE SPILL: DESTROY BY LIQUID INCINERATION WITH OFF-GAS SCRUBBER. CONTAMINATED ABSORBENT MAY BE DEPOSITED IN A LANDFILL IN ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.

SECTION VIII-PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: IF TLV OF THE PRODUCT OR ANY COMPONENT IS EXCEEDED, A NIOSH/MSHA JOINTLY APPROVED AIR SUPPLIED RESPIRATOR IS ADVISED IN ABSENCE OF PROPER ENVIRONMENTAL CONTROL. OSHA REGULATIONS ALSO PERMIT OTHER NIOSH/MSHA RESPIRATORS UNDER SPECIFIED CONDITIONS. (SEE YOUR SAFETY EQUIPMENT SUPPLIER). ENGINEERING OR ADMINISTRATIVE CONTROLS SHOULD BE IMPLEMENTED TO REDUCE EXPOSURE.

VENTILATION: PROVIDE SUFFICIENT MECHANICAL (GENERAL AND/OR LOCAL EXHAUST) VENTILATION TO MAINTAIN EXPOSURE BELOW TLV(S).

PROTECTIVE GLOVES: WEAR RESISTANT GLOVES SUCH AS: POLYVINYL ALCOHOL, POLYETHYLENE

EYE PROTECTION: CHEMICAL SPLASH GOGGLES IN COMPLIANCE WITH OSHA REGULATIONS ARE ADVISED, HOWEVER, OSHA REGULATIONS ALSO PERMIT OTHER TYPE SAFETY GLASSES. (CONSULT YOUR SAFETY EQUIPMENT SUPPLIER)

OTHER PROTECTIVE EQUIPMENT: TO PREVENT REPEATED OR PROLONGED SKIN CONTACT, WEAR IMPERVIOUS CLOTHING AND BOOTS.

SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS

CONTAINERS OF THIS MATERIAL MAY BE HAZARDOUS WHEN EMPTIED SINCE EMPTIED CONTAINERS RETAIN PRODUCT RESIDUES (VAPOR, LIQUID, AND/OR SOLID), ALL HAZARD PRECAUTIONS GIVEN IN THE DATA SHEET MUST BE OBSERVED.

AVOID CONTACT WITH PLASTIC AND RUBBER I.E. EQUIPMENT, PROTECTIVE CLOTHING, AND CONTAINERS.

OVEREXPOSURE TO MATERIAL HAS APPARENTLY BEEN FOUND TO CAUSE THE FOLLOWING EFFECTS IN LABORATORY ANIMALS: LIVER ABNORMALITIES, KIDNEY DAMAGE, LUNG DAMAGE

72-62-7828-01

**MATERIAL SAFETY
DATA SHEET**

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PMC 90

804621

TRICHLORETHAN 111 DEGRS COLD/V

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SECTION IX-SPECIAL PRECAUTIONS OR OTHER COMMENTS (CONTINUED)

OVEREXPOSURE TO MATERIAL HAS BEEN SUGGESTED AS A CAUSE OF THE FOLLOWING EFFECTS
IN HUMANS: CARDIAC ABNORMALITY, LIVER ABNORMALITIES, KIDNEY DAMAGE, LUNG
DAMAGE

THE INFORMATION ACCUMULATED HEREIN IS BELIEVED TO BE ACCURATE BUT IS NOT
WARRANTED TO BE WHETHER ORIGINATING WITH ASHLAND OR NOT. RECIPIENTS ARE
ADVISED TO CONFIRM IN ADVANCE OF NEED THAT THE INFORMATION IS CURRENT,
APPLICABLE, AND SUITABLE TO THEIR CIRCUMSTANCES.

UTCH@

Material Safety Data Sheet

PPG Industries, Inc.
One PPG Place
Pittsburgh, PA 15272

Approved by U.S. Dept. of Labor as Essentially Similar to Form OSHA 20

Date: November, 1985	Edition: Eighth
Chemical Name and Synonyms: 1,1,1-trichloroethane; methylchloroform CAS No. 71-55-6	Trade Name and Synonyms: TRI-ETHAN
Chemical Family: Halogenated Hydrocarbons	Formula: CH_3CCl_3
DOT Shipping Name: See Comments, Page 2	DOT Hazard Class: See Comments, Page 2
Reportable Quantity: N/A See Comments, I. D. Number, Page 2	Subsidiary Risk: N/A

SECTION 1 • PHYSICAL DATA

Boiling Point @ 760 mm Hg: 72°C	Vapor Density (Air=1): 4.54	Specific Gravity ($\text{H}_2\text{O}=1$): 1.300-1.320 @ 25/25°C	pH of Solutions: 6.0 to 7.5
Boiling Range 72°C-88°C			
Freezing/Melting Point: -45°C	Solubility (Weight % in Water): Negligible	Bulk Density: 10.80-10.97 lbs/gal @ 25°C	Volume % Volatile: 100
Vapor Pressure: 135mmHg @ 25°C	Evaporation Rate (ethyl ether=1): 0.35	Heat of Solution: Not Applicable	Appearance and Odor: Clear, colorless liquid with ether-like odor

SECTION 2 • INGREDIENTS

	RECEIVED	%
1,1,1-trichloroethane (Stabilized)		
Diethylene ether (CAS No. 123-91-1)	FEB 3 1986	96
Glycol methylene ether (CAS No. 646-06-0)		
Sec butanol (CAS No. 78-92-2)	INDUSTRIAL HYGIENE	
NOTE: Hazard information is based upon the tested mixture and not individual ingredients.		

SECTION 3 • FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used) None when tested in accordance with DOT requirements	Flammable Limits in Air (% by Volume) LEL: 7% UEL: 15% (See Below)	Extinguishing Media: Water, dry chemicals or carbon dioxide
Special Fire Fighting Procedures: Fire fighters should wear NIOSH/MSHA-approved pressure-demand, self-contained breathing apparatus for possible exposure to hydrogen chloride and possible traces of phosgene.		

Unusual Fire and Explosion Hazards: Vapors concentrated in a confined or poorly ventilated area can be ignited upon contact with a high energy spark, flame, or high intensity source of heat. This can occur at concentrations ranging between 7-15% by volume. Decomposition or burning can produce hydrogen chloride or possible traces of phosgene.

SECTION 4 • HEALTH HAZARD DATA

Toxicity Data See References 1-7	Classification (Poison, Irritant, Etc.)
LC ₅₀ Inhalation (rat) 8,000 ppm/7 hours	Inhalation: Slightly Toxic
LD ₅₀ Dermal (rabbit) >15 g/kg	Skin: Not Significantly Toxic
Skin/Eye Irritation See Section 5	Skin/Eye: Liquid mildly irritating to skin; eye irritant
LD ₅₀ Ingestion (rat) 10-12 g/kg (rabbit; guinea pig) 5.6-9.5 g/kg	Ingestion: Not Significantly Toxic
Fish, LC ₅₀ (Lethal Concentration) Unknown	Aquatic: Unknown

SECTION 5 - EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Permissible Exposure Limits:

OSHA: 350 ppm, 8-hour TWA (time-weighted average); 29CFR 1910.1000

ACGIH: 350 ppm, 8-hour TWA (time-weighted average); 450 ppm, STEL, (15-minute short-term exposure limit).

ACUTE

Inhalation: Tri-Ethane® is primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory system, dizziness, nausea, lightheadedness, headache, loss of coordination and equilibrium, unconsciousness, possible central nervous system damage and even death in confined or poorly ventilated areas. Fatalities following severe acute exposure to various chlorinated solvents have been attributed to ventricular fibrillation.

Eye/Skin: Liquid splashed in the eye can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes, and skin absorption can occur.

Ingestion: Swallowing of this material may result in irritation of the mouth and GI tract with other effects as listed above for Inhalation. Vomiting and subsequent aspiration into the lungs may lead to chemical pneumonia and pulmonary edema which is a potentially fatal condition.

CHRONIC

Tri-Ethane® has been extensively studied for cancer potential. There is no documented evidence to suggest that Tri-Ethane® causes an increased cancer incidence in humans or animals. The EPA's Science Advisory Board concluded that there is no evidence to suggest carcinogenic activity for Tri-Ethane®. 1,1,1-trichloroethane is not listed by IARC, NTP, or OSHA as a carcinogen.

References (continued)

5. Toxicity and Metabolisms of Industrial Solvents, Browning, 1965
 6. Toxicology, the Basic Science of Poisons, Casarett and Doull, 1975
 7. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980
 8. Encyclopedia of Chemical Technology, Volume 5, Third Edition, Kirk-Othmer, 1979
 9. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards, DHHS (NIOSH) Publication No. 81-123, January, 1981
 10. NIOSH/OSHA Pocket Guide to Chemical Hazards, DHEW (NIOSH) Publication No. 78-210, September, 1978
-

COMMENTS: Only regulated when shipped by air. DOT Shipping Name is 1,1,1-trichloroethane, DOT Hazard Class is ORM-A, and UN Number is UN2831.

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician. Thoroughly clean contaminated clothing and shoes before reuse or discard.

Ingestion: If conscious, drink large quantities of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital. DO NOT attempt to give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following Tri-Ethane® overexposure. Increased sensitivity of the heart to adrenalin may be caused by overexposure to Tri-Ethane®.

SECTION 6. REACTIVITY DATA

Stability: Stable	Conditions to Avoid: Avoid open flames, hot glowing surfaces or electric arcs.
--------------------------	---

Hazardous Polymerization: Will not occur.	Conditions to Avoid: None
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Incompatibility (Materials to Avoid): Avoid mixing with caustic soda, caustic potash, or oxidizing materials. Shock sensitive compounds may be formed.

Hazardous Decomposition Products: Hydrogen chloride and possible traces of phosgene.

SECTION 7. SPILL OR LEAK PROCEDURES

Steps to be Taken if Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection (See Section 8) should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover spilled material on adsorbents, such as sawdust and vermiculite and sweep into closed containers for disposal. After all visible traces, including ignitable vapors, have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc. as necessary and place in closed containers for disposal.

Waste Disposal Method:

Contaminated sawdust, vermiculite, or porous surfaces must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers to prevent environmental contamination. It is your duty to dispose of the chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act, as well as any other relevant federal, state, or local laws/regulations regarding disposal.

SECTION 8 - SPECIAL PROTECTION INFORMATION

Respiratory Protection: Use a half or full facepiece organic vapor chemical cartridge or canister respirator when concentrations exceed permissible limits. Use self-contained breathing apparatus (SCBA) or full facepiece airline respirator with auxiliary SCBA operated in the pressure-demand mode for emergencies and for all work performed in storage vessels, poorly ventilated rooms, and other confined areas. Respirators must be approved by NIOSH or MSHA. The respirator use limitations made by NIOSH/MSHA^{9,10} and by the manufacturer must be observed. Respiratory protection programs must be in accordance with 29CFR 1910.134.

Ventilation (Type): Use local exhaust or dilution ventilation as appropriate to control exposures to below permissible limits.

Eye Protection: Splashproof goggles

Gloves: Viton®. For limited service only: Polyvinyl alcohol*, Nitrile, Butyl, Neoprene. *(degrades in water)

Other Protective Equipment: Boots, aprons, or chemical suits should be used when necessary to prevent skin contact. Personal protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 - SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined areas without proper respiratory protection (See Section 8).
- Tri-Ethane® vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Store only in closed, properly labeled containers.
- Liquid oxygen or other strong oxidants may form explosive mixtures with Tri-Ethane®.
- This material or its vapors when in contact with flames, hot glowing surfaces, or electric arcs can decompose to form hydrogen chloride and possible traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES. Handling, storage, and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.
- Do not store or stack aluminum in contact with Tri-Ethane® to prevent possible solvent decomposition (stacking corrosion).
- Caution should be taken not to use in pressurized or totally enclosed system of aluminum construction. Example: paint or adhesive spray system.
- A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable component.
- Do not use cutting or welding torches on empty drums that contained Tri-Ethane® unless properly purged and cleaned.

Other Precautions:

- Do not breathe vapors. High vapor concentrations can cause dizziness, unconsciousness, possible central nervous system damage or death.
- Use only with adequate ventilation. Ventilation must be sufficient to limit employee exposure to Tri-Ethane® below permissible exposure limits. Observance of lower limits (outlined in Section 5) is advisable.
- Avoid contact with eyes. Will cause irritation and pain.
- Avoid prolonged or repeated contact with skin. May cause irritation or dermatitis.
- Do not swallow. Swallowing may cause injury or death.
- Do not eat, drink, or smoke in work areas.

References:

1. NIOSH Registry of Toxic Effects of Chemical Substances, 1975
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fourth Edition, N. I. Sax, 1975
4. Industrial Toxicology, Hamilton and Hardy, 1974

(References continued on page 2)

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U.S. DEPARTMENT OF LABOR
WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

PMC 9036

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G. E. PARSON

MATERIAL SAFETY DATA SHEET

Supplier: Axton-Cross 617-
Holliston, Mass. 424-6744 SECTION I

add. info in file

MANUFACTURER'S NAME
PPG Industries, Inc.

EMERGENCY TELEPHONE NO.
(318) 882-1200

ADDRESS (Number, Street, City, State, and ZIP Code)
No. 1 Gateway Center, Pittsburgh, Pa. 15222

CHEMICAL NAME AND SYNONYMS
* 1,1,1-trichloroethane, methylchloroform

TRADE NAME AND SYNONYMS
TRI-ETHANE, AXOTHENE

CHEMICAL FAMILY
Chlorinated Hydrocarbons

FORMULA
 CH_3CCl_3

SECTION II HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS	100	350	FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
* Stabilized (according to label) (old MSDS: 1,1,1 trichloroethane)					
letter, B.L. Finocchio: 3-3-78, does not contain 1,4 dioxane					

SECTION III PHYSICAL DATA

BOILING POINT (°F.)	165.4	SPECIFIC GRAVITY ($\text{H}_2\text{O} = 1$)	1.31
VAPOR PRESSURE (mm Hg.)	120	PERCENT VOLATILE BY VOLUME (%)	100
VAPOR DENSITY (AIR = 1)	4.54	EVAPORATION RATE (ether = 1)	0.35
SOLUBILITY IN WATER	Negligible		
APPEARANCE AND ODOR	Colorless appearance, ethereal odor		

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	None (Tag, open or closed)	FLAMMABLE LIMITS	Let	Unit
EXTINGUISHING MEDIA				
SPECIAL FIRE FIGHTING PROCEDURES				
INITIAL FIRE AND EXPLOSION HAZARDS	Vapors can be ignited only by high intensity source of ignition. Combustion forms HCl and possible traces of phosgene.			

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SECTION V. HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE 350 ppm

EFFECTS OF OVEREXPOSURE Loss of co-ordination and equilibrium to actual unconsciousness, and even death, in unventilated areas (such as tanks).

IMMEDIATE FIRST AID PROCEDURES Move to fresh air, use artificial respiration if breathing has stopped. Administer oxygen after breathing has been restored. (Never administer adrenalin!) Call physician (he should not administer adrenalin).

SECTION VI. REACTIVITY DATA

STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE	X	

INCOMPATIBILITY (Materials to avoid) Avoid mixing with caustic soda and caustic potash.

HAZARDOUS DECOMPOSITION PRODUCTS HCl and possible traces of phosgene.

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII. SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Adequate ventilation must be provided. Workmen should be provided with fresh air mask or sent to fresh air.

WASTE DISPOSAL METHOD Forced ventilation or evaporation.

SECTION VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type) Fresh air masks

VENTILATION	LOCAL EXHAUST	Sufficient to maintain TLV	SPECIAL
	MECHANICAL (General)		OTHER

PROTECTIVE GLOVES Neoprene or Viton EYE PROTECTION Glasses or goggles

OTHER PROTECTIVE EQUIPMENT Neoprene apron

SECTION IX. SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

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ADDENDUM TO MATERIAL SAFETY DATA SHEETON TRI-ETHANE 1,1,1-TRICHLOROETHANE (December, 1977)SECTION IV -- FIRE AND EXPLOSION HAZARD DATA

Flash Point - None when tested in accordance with standard accepted laboratory techniques; however, 1,1,1-trichloroethane vapors concentrated in a confined or poorly ventilated area can be ignited upon contact with a spark, flame or high-intensity source of heat. This can occur at concentrations ranging between 8 percent and 15 percent by volume.

SECTION V -- HEALTH HAZARD DATA

Acute Toxicity Values⁽¹⁾ - Oral LD₅₀ (rat): 10 - 12 gm/kg.
Oral LD₅₀ (rabbit, guinea pig): 5.6 - 9.5 gm/kg
Inhalation LC₅₀ (rat): 8,000 ppm/7 hours

Effects of Overexposure

Acute: Primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory system, dizziness, nausea, lightheadedness, headache, loss of coordination and equilibrium, unconsciousness, and even death in confined or poorly ventilated areas. Depression of the circulatory system has been reported as a result of overexposure to methyl chloroform. Ventricular arrhythmia may be induced after sensitization to epinephrine.

Eye contact can result in discomfort, pain and irritation. Prolonged or repeated contact with the skin can cause irritation and dermatitis.

Chronic: Torkelson, et. al. (1959) reported that female guinea pigs had slight inflammation of lungs and fatty changes in liver at chronic exposure concentrations of 2,000 ppm, although no evidence can presently be found to confirm any chronic exposure hazard to humans.

Emergency and First Aid Procedures

Inhalation Overexposure: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Note to Physician: Avoid use of adrenalin in any case where a person has been overcome by 1,1,1-trichloroethane.

Eye Contact: Flush with plenty of water for at least fifteen minutes. If irritation occurs, consult a physician.

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Skin Contact: Wash thoroughly with plenty of soap and water. If irritation occurs, consult a physician.

Swallowing: If conscious, drink a quart of water then induce vomiting by placing a finger far back in the throat. Call a physician. If vomiting cannot be induced, take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital or physician. DO NOT induce vomiting or give anything by mouth.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection -- NIOSH/MESA approved organic vapor respirator for concentrations below 1000 ppm. For 1000 ppm and above, use air-supplied respiratory protection. Consult 29 CFR 1910.134 for details.

SECTION IX -- SPECIAL PRECAUTIONS

Precautions to be Taken in Handling and Storing

- Do not use in poorly ventilated or confined spaces.
- Keep containers tightly closed when not in use.
- Do not store in open, unlabeled or mislabeled containers.
- Do not store degreaser clean-out sludge in tightly sealed containers.
- Sludge containing finely divided aluminum residues should be stored out of doors away from combustible materials.
- Liquid oxygen or other strong oxidizers may form explosive mixtures with 1,1,1-trichloroethane when mixed in confined areas.
- Under certain conditions, decomposition may occur followed by release of hydrogen chloride vapors when 1,1,1-trichloroethane is blended with other organic materials such as toluene. Before performing any such blending operations, consult with PPG on potential hazards involved.

Other Precautions

- Avoid prolonged or repeated breathing of vapor.
- Use only with ventilation sufficient to limit employee exposure below OSHA permissible exposure limit.
- Avoid contact with eyes.
- Avoid prolonged or repeated contact with skin.
- Do not take internally.

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REFERENCES

- (1) NIOSH Registry of Toxic Effects of Chemical Substances, 1975.
- (2) Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963.
- (3) Dangerous Properties of Industrial Materials, Fourth Edition, N. I. Sax, 1975.
- (4) Industrial Toxicology, Hamilton and Hardy, 1974.
- (5) Toxicity and Metabolisms of Industrial Solvents, Browning, 1965.
- (6) Toxicology, the Basic Science of Poisons, Casarett and Doull, 1975.

PMC 9056

Material Safety Data Sheet

MSD 8208.20

DETREX CHEMICAL INDUSTRIES, INC.
P.O. BOX 501
DETROIT, MICHIGAN 48232

MAR 2 1981

INDUSTRIAL HYDROGEN

Approved by U.S. Dept. of Labor as "Essentially similar" to Form OSHA-20



Date: August, 1982	Edition: First	UTCIHL 8
Chemical Name and Synonyms: 1,1,1-trichloroethane: methylchloroform CAS No. 71-55-6	Trade Name and Synonyms: PERM-ETHANE • DG	
Chemical Family: Halogenated Hydrocarbons	Formula: CH_3CCl_3	
DOT Shipping Name: 1,1,1-trichloroethane	DOT Hazard Class: ORM-A	
	I. D. Number: UN 2831	

SECTION 1 - PHYSICAL DATA

Boiling Point @ 760 mm Hg: 165.4°F	Vapor Density (Air=1): 4.54	Specific Gravity ($\text{H}_2\text{O}=1$): 1.300-1.320 @ 25°/25°C	pH of Solutions: 6.0 to 7.5
Freezing/Melting Point: -49°F -45°C	Solubility (Weight % in Water): Negligible	Bulk Density: 10.80-10.97 lbs/gal @ 25°C	Volume % Volatile: Essentially 100
Vapor Pressure: @ 25°C = 135 mmHg	Evaporation Rate (ethyl ether = 1): 0.35	Heat of Solution: Not Applicable	Appearance and Odor: Clear, colorless liquid - ether-like odor.

SECTION 2 - HAZARDOUS INGREDIENTS

	%	Hazard Data
1,1,1-trichloroethane (Stabilized)	100	See Sections 4 & 5

SECTION 3 - FIRE AND EXPLOSION HAZARD DATA

Flash Point °F (Method Used) None when tested in accordance with DOT requirements.	Flammable Limits in Air (% by Volume) LEL: 7% UEL: 15% See Below	Extinguishing Media: water, dry chemical or carbon dioxide
Special Fire Fighting Procedures: Fire fighters should wear a NIOSH/MSHA-approved pressure-demand, self-contained breathing apparatus for possible exposure to hydrogen chloride and possibly traces of phosgene. Use water only in degreasers when aluminum reaction occurs.		
Unusual Fire and Explosion Hazards: Vapors concentrated in a confined or poorly ventilated area can be ignited upon contact with a spark, flame, or high intensity source of heat. This can occur at concentrations ranging between 7-15% by volume. Decomposition or burning can produce hydrogen chloride or possibly traces of phosgene. Also see Detrex warning letter Form SoL 8208.21 attached.		

SECTION 4 - HEALTH HAZARD DATA

Toxicity Data	Classification (Poison, Irritant, Etc.)
LC ₅₀ Inhalation (rat) 8,000 ppm/7 hours	Inhalation: Toxic
LD ₅₀ Dermal (rabbit) 15g/kg ⁽²⁾	Skin/Eye: Liquid mildly irritating to skin; eye irritant
LD ₅₀ Ingestion (rat) 10-12g/kg (See Section 5)	Ingestion: Not significantly toxic
Fish, LC ₅₀ (Lethal Concentration) Not Determined	Aquatic:
Human Exposure Information/Data:	

24-HOUR EMERGENCY ASSISTANCE: (313) 358-5800

SECTION 5 - EFFECTS OF OVEREXPOSURE

This section covers effects of overexposure for inhalation, eye/skin contact, ingestion and other types of overexposure information in the order of the most hazardous and the most likely route of overexposure.

Permissible Exposure Limits (TLV):

350 ppm - 8-hour time-weighted average (TWA) - OSHA 29CFR 1910.1000 (May 28, 1975).

Acute

Primarily a central nervous system depressant. Inhalation can cause irritation of the respiratory system, dizziness, nausea, lightheadedness, headache, loss of coordination and equilibrium, unconsciousness and, if exposed to high concentrations in confined or poorly ventilated areas, even death. Depression of the circulatory system has been reported as a result of overexposure to 1,1,1-trichloroethane. The heart may be sensitized by overexposure and ventricular arrhythmia may be induced by epinephrine administration.

Liquid splashed in the eyes can result in discomfort, pain and irritation. Prolonged or repeated contact with liquid on the skin can cause irritation and dermatitis. The problem may be accentuated by liquid becoming trapped against the skin by contaminated clothing and shoes. Skin absorption can occur.

Chronic

Prolonged exposure above the OSHA permissible exposure limits may result in liver and kidney damage. 1,1,1-trichloroethane has been extensively studied for cancer both in the U.S. and Europe by government, industry and academia. There is no documented evidence that 1,1,1-trichloroethane causes an increased cancer incidence in humans.

EMERGENCY AND FIRST AID PROCEDURES:

Inhalation: Remove to fresh air. If not breathing, give artificial respiration, preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call a physician.

Eye or Skin Contact: Flush eyes and skin with plenty of water (soap and water for skin) for at least 15 minutes, while removing contaminated clothing and shoes. If irritation occurs, consult a physician.

Ingestion: If conscious, drink large quantities of water. DO NOT induce vomiting. Take immediately to a hospital or physician. If unconscious, or in convulsions, take immediately to a hospital. DO NOT give anything by mouth to an unconscious person.

Notes to Physician (Including Antidotes): NEVER administer adrenalin following 1,1,1-trichloroethane overexposure. Increased sensitivity of the heart to adrenalin may be caused by overexposure to 1,1,1-trichloroethane.

SECTION 6. REACTIVITY DATA

Stability: Stable

Conditions to Avoid: Avoid open flames, hot glowing surfaces or electric arcs.

Hazardous Polymerization:
Will not occur.

Conditions to Avoid:
None

Incompatibility (Materials to Avoid):

Avoid contamination with caustic soda, caustic potash or oxidizing materials. Shock sensitive explosives may be formed. Avoid contact with aluminum, magnesium, zinc and alloys thereof under high pressures. See Detrex warning letter Form Sol 8208.21 attached.

Hazardous Decomposition Products:

Hydrogen chloride and possibly traces of phosgene.

SECTION 7. SPILL OR LEAK PROCEDURES (See Detrex Forms Sol 8208.14 and Sol 8208.15 attached)

Steps to be Taken if Material is Spilled or Released: Immediately evacuate the area and provide maximum ventilation. Unprotected personnel should move upwind of spill. Only personnel equipped with proper respiratory and skin/eye protection should be permitted in area. Dike area to contain spill. Take precautions as necessary to prevent contamination of ground and surface waters. Recover or absorb spilled material on sawdust or vermiculite and sweep into closed containers for disposal. After all visible traces have been removed, thoroughly wet vacuum the area. DO NOT flush to sewer. If area of spill is porous, remove as much contaminated earth and gravel, etc., as necessary and place in closed containers for disposal. (See Below)

Waste Disposal Method: Contaminated sawdust, vermiculite or porous surface must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be re-processed or incinerated or must be treated in a permitted hazardous waste management facility. Care must be taken when using or disposing of chemical materials and/or their containers to prevent environmental contamination. It is your duty to dispose of the chemical materials and/or their containers in accordance with the Clean Air Act, the Clean Water Act, the Resource Conservation and Recovery Act as well as any other relevant federal, state or local laws/regulations regarding disposal.

SECTION 8 • SPECIAL PROTECTION INFORMATION

Respiratory Protection: For emergencies or working in confined areas, wear self-contained breathing apparatus or supplied air respiratory protection (use the "buddy system" and wear a safety harness with a lifeline). In other circumstances involving potential overexposure, use NIOSH/MSHA-approved organic vapor respirator. (Observe limitations directed by manufacturer.) Respiratory protection program must be in accordance with 29CFR 1910.134.

Ventilation (Type): Dilution (General) or Local Exhaust - Sufficient to maintain workplace concentration below permissible exposure limits.

Eye Protection: Splashproof Goggles **Gloves:** polyethylene, neoprene or polyvinyl alcohol

Other Protective Equipment: Safety shower and eye-wash fountain in immediate area. Personnel protective clothing and use of equipment must be in accordance with 29CFR 1910.133 and 29CFR 1910.132.

SECTION 9 • SPECIAL PRECAUTIONS

Precautions to be Taken During Handling and Storing:

- Do not use in poorly ventilated or confined areas.
- 1,1,1-trichloroethane vapors are heavier than air and will collect in low areas.
- Keep container closed when not in use.
- Do not store in open, unlabeled or mislabeled containers.
- Liquid oxygen or other strong oxidants may form explosive mixtures with 1,1,1-trichloroethane.
- This material or its vapors when in contact with flames, hot glowing surfaces or electric arcs can decompose to form hydrogen chloride gas and traces of phosgene.
- AVOID CONTAMINATION OF WATER SUPPLIES: Handling, storage, and use procedures must be carefully monitored to avoid spills or leaks. Any spill or leak has the potential to cause underground water contamination which may, if sufficiently severe, render a drinking water source unfit for human consumption. Contamination that does occur cannot be easily corrected.
- A chlorinated solvent used as a flashpoint suppressant must be added in sufficient quantity or the resultant mixture may have a flashpoint lower than the flammable component.
- Caution should be taken not to use in pressurized or totally enclosed system of light metal construction such as aluminum, magnesium, zinc or alloys thereof. Example, paint or adhesive spray system. (See Detrex Form Sol 8208.21 attached.)

Other Precautions:

- AVOID PROLONGED OR REPEATED BREATHING OF VAPORS. High vapor concentrations can cause dizziness, unconsciousness or death. Long-term overexposure may cause liver/kidney injury.
- USE ONLY WITH ADEQUATE VENTILATION. Ventilation must be sufficient to limit employee exposure to 1,1,1-trichloroethane below OSHA permissible limits (8-hour TWA 350 ppm). Observance of lower limits (outlined in Section 4) is advisable.
- AVOID CONTACT WITH EYES. Will cause irritation and pain.
- AVOID PROLONGED OR REPEATED CONTACT WITH SKIN. May cause irritation or dermatitis.
- DO NOT TAKE INTERNALLY. Swallowing may cause injury or death.
- DO NOT EAT, DRINK, OR SMOKE IN WORK AREAS.

References:

1. NIOSH Registry of Toxic Effects of Chemical Substances, 1978
2. Industrial Hygiene and Toxicology, Volume II, Second Edition, F. A. Patty, 1963
3. Dangerous Properties of Industrial Materials, Fifth Edition, N. L. Sax, 1979
4. Industrial Toxicology, Hamilton and Hardy, 1974
5. Toxicity and Metabolism of Industry Solvents, Browning, 1965
6. Toxicology, the Basic Science of Poisons, Casarett and Doull, 1980
7. Federal Register, 45FR Hazardous Waste Management Systems Part III, Identification and Listing of Hazardous Wastes, Page 33084, May 19, 1980
8. EPA Science Advisory Board, Subcommittee on Airborne Carcinogens, September, 1980

Comments:

As this solvent (1,1,1-trichloroethane) is used to clean and/or degrease a wide variety of metal and plastic parts, it should always be used in conjunction with properly designed and fully controlled degreasing equipment that is in compliance with the U.S. Environmental Protection Agency, QA/QS Guidelines, "Control of Volatile Organic Emissions from Solvent Metal Cleaning", and/or all other applicable federal, state and local regulatory guidelines.

(R) INDICATES A REGISTERED OR TRADEMARK NAME OF THE DOW CHEMICAL COMPANY

PMC 9056

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M A T E R I A L S A F E T Y D A T A S H E E T PAGE: 2
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400
PRODUCT (CONT'D): CHLOROTHENE (R) VG PRODUCT CODE: 16822
MSD: 0110

SEP 9 '82

SECTION 4 SPILL, LEAK, AND DISPOSAL PROCEDURES (CONTINUED)
DISPOSAL METHOD: (CONTINUED)
ALLOWED TO EVAPORATE SAFELY. REFER TO CHEMICAL SAFETY DATA SHEET
SD-90, MANUFACTURING CHEMISTS ASSOCIATION, 1825 CONNECTICUT AVENUE,
WASHINGTON, D. C. 20009.

SECTION 5 HEALTH HAZARD DATA

SECTION: VERY LOW TOXICITY. LD50 (LABORATORY ANIMALS) RANGES FROM
6 TO 14.0 G/KG.
CONTACT: MILD IRRITATION, BUT ESSENTIALLY NO CORNEAL INJURY.
EYE CONTACT: SHORT CONTACT - NO IRRITATION. PROLONGED OR
FREQUENT EXPOSURE - MINOR IRRITATIONS. IF CONFINED TO THE SKIN -
UP TO MODERATE IRRITATION, EVEN A BURN.
SKIN ABSORPTION: VERY LOW. LD50 (RABBITS) - 24 HOUR EXPOSURE - GREATER
THAN 1.5 G/KG.
INHALATION: TLV: 350 PPM (1974).
EFFECTS OF OVEREXPOSURE: ANESTHETIC EFFECTS - MAY OCCUR IN THE RANGE
OF 500 TO 1000 PPM.

07

SECTION 6 FIRST AID--NOTE TO PHYSICIAN

FIRST AID PROCEDURES: CAUTION - NEVER GIVE FLUIDS OR INDUCE VOMITING IF
PATIENT IS UNCONSCIOUS OR HAVING CONVULSIONS.
EYES: FLUSH EYES WITH PLENTY OF WATER, GET MEDICAL ATTENTION IF
IRRITATION OR INJURY DEVELOPS.
SKIN: FLUSH SKIN WITH PLENTY OF WATER, GET MEDICAL ATTENTION IF
IRRITATION OR INJURY DEVELOPS.
INHALATION: IF BREATHING STOPS, GIVE ARTIFICIAL RESPIRATION. GET
MEDICAL HELP. REMOVE TO FRESH AIR; KEEP WARM AND QUIET UNTIL
RECOVERED.
INGESTION: INDUCE VOMITING. CALL A PHYSICIAN IMMEDIATELY. NO
SPECIFIC ANTIDOTE KNOWN. TREAT SYMPTOMATICALLY. CAUTION: WITH SOME
SOLVENTS, DRINKING ALCOHOL SHORTLY BEFORE, DURING OR AFTER EXPOSURE
MAY CAUSE UNDESIRABLE EFFECTS.
NOTE TO PHYSICIAN: OVEREXPOSURE TO MANY OF THE CHLORINATED SOLVENTS,
ESPECIALLY IF ACCOMPANIED BY ANOXIA, MAY TEMPORARILY INCREASE CARDIAC
IRRITABILITY. MAINTAIN ADEQUATE OXYGENATION UNTIL RECOVERY. AVOID
SYMPATOMIC AMINES, SUCH AS EPINEPHRINE, WHICH MAY PRECIPITATE
ARRHYTHMIAS.

SECTION 7 SPECIAL HANDLING INFORMATION

VENTILATION: LIMIT CONCENTRATION IN AIR TO TLV.
RESPIRATORY PROTECTION: BELOW 350 PPM - NONE. RESPIRATORY PROTECTION
REQUIRED IN THE ABSENCE OF ENVIRONMENTAL CONTROL. FOR LEVELS UP TO 2%

(CONTINUED ON PAGE 3)

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M A T E R I A L S A F E T Y D A T A S H E E T PAGE: 3
DOW CHEMICAL U.S.A. MIDLAND MICHIGAN 48640 EMERGENCY PHONE: 517-636-4400
PRODUCT (CONT'D): CHLOROTHENE (R) VG PRODUCT CODE: 16822
MSD: 0110

SECTION 7 SPECIAL HANDLING INFORMATION (CONTINUED)
RESPIRATORY PROTECTION: (CONTINUED)
FOR 1/2 HOUR OR LESS, A SUITABLE FULL - FACE MASK WITH ORGANIC
CANISTER SHOULD BE USED. ABOVE 2 PERCENT AND FOR EMERGENCIES, USE A
SELF - CONTAINED BREATHING APPARATUS.
PROTECTIVE CLOTHING: NO SPECIAL PROTECTIVE CLOTHING NEEDED.
EYE PROTECTION: SAFETY GLASSES WITHOUT SIDE SHIELDS. EYE - WASH
STATIONS AND SAFETY SHOWERS SHOULD BE READILY AVAILABLE.

SECTION 8 SPECIAL PRECAUTIONS AND ADDITIONAL INFORMATION
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: HANDLE WITH REASONABLE
CARE. AVOID BREATHING VAPORS. STORE IN A COOL DRY PLACE. VAPORS
OF THIS PRODUCT ARE HEAVIER THAN AIR AND WILL COLLECT IN LOW AREAS
SUCH AS PITS, DEGREASERS, STORAGE TANKS, AND OTHER CONFINED AREAS.
DO NOT ENTER THESE AREAS WHERE VAPORS OF THIS PRODUCT ARE SUSPECTED
UNLESS SPECIAL BREATHING APPARATUS IS USED AND AN OBSERVER IS
PRESENT FOR ASSISTANCE.

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ADDITIONAL INFORMATION, IF ANY: ----

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LAST PAGE

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THE INFORMATION HEREIN IS GIVEN IN GOOD FAITH, BUT NO WARRANTY,
EXPRESS OR IMPLIED, IS MADE.

Vulcan CHEMICALS

Division of Vulcan Materials Company

UTC IHL 8

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Southington Maintenance Center

PMC 9056

JAN 3

G. E. PARSONS

MATERIAL SAFETY DATA SHEET

ESSENTIALLY SIMILAR TO FORM OSHA-20)

SEE IMPORTANT NOTICE ON BOTTOM OF OTHER SIDE

24 Hour Emergency Phone (316) 524-5751

I - PRODUCT IDENTIFICATION

MANUFACTURER'S NAME AND ADDRESS

Vulcan Materials Company, Chemicals Division, P. O. Box 7689, Birmingham, AL 35253-0689

CHEMICAL NAME

1,1,1-Trichloroethane, Methyl Chloroform

CHEMICAL FORMULA

CH3CCl3

TRADE NAME AND SYNONYMS

Solvent 111®

CHEMICAL FAMILY

Chlorinated Hydrocarbon

CAS REGISTRY NO.

71-55-6

DOT IDENTIFICATION NO.

UN 2831

II - HAZARDOUS INGREDIENTS

MATERIAL OR COMPONENT

1,1,1 Trichloroethane (stabilized)

% (wt)

100

PEL (Unex)

350ppm

III - PHYSICAL DATA

BOILING POINT (°F.)

162-190°F

SPECIFIC GRAVITY (H₂O=1)

1.3

VAPOR PRESSURE (mm Hg.)

@20°C 100

PERCENT, VOLATILE BY VOLUME (%)

100

VAPOR DENSITY (AIR=1)

4.6

EVAPORATION RATE (ether=1)

0.4

SOLUBILITY IN WATER

0.07g/100g @ 25°C

APPEARANCE AND ODOR

Colorless clear liquid; mildly sweet odor.

IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)

None (TOC)

FLAMMABLE LIMITS

Lower

Upper

in air @ 25°C

7.5% (vol)

15.0% (vol)

EXTINGUISHING MEDIA

Foam, Dry Chemical, Carbon dioxide

SPECIAL FIRE FIGHTING PROCEDURES

Self-contained breathing apparatus should be used in areas where 1,1,1-trichloroethane is stored.

UNUSUAL FIRE AND EXPLOSION HAZARDS

Concentrated vapors can be ignited by high intensity heat source.

Decomposition produces hydrogen chloride.

V - REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID

STABLE

Contact with open flame, hot surfaces or electric arcs

INCOMPATIBILITY (Materials to avoid)

Strong alkalies, oxidizing materials

HAZARDOUS DECOMPOSITION PRODUCTS

Hydrogen chloride, phosgene (small amounts)

HAZARDOUS POLYMERIZATION

MAY OCCUR

CONDITIONS TO AVOID

VI - HEALTH HAZARD DATA		PMC 9056
OSHA PERMISSIBLE EXPOSURE LIMIT	350 ppm 8 hour TWA. (29 CFR part 1910.1000)	
ACGIH:	350 ppm 8 hour TLV; 450 ppm 15 min STEL.	
EFFECTS OF OVEREXPOSURE		
INHALATION: Major route of exposure - low systemic toxicity; acute exposures in the 1000 ppm range cause narcosis. Overexposure can cause dizziness, drunkenness and drowsiness, unconsciousness and even death at extreme doses.		
SKIN CONTACT/ABSORPTION: Prolonged or repeated skin contact can cause dermatitis through defatting of skin. Absorption through skin is not a significant route of exposure - mildly irritating on contact.		
INGESTION: Unlikely route of exposure, ingestion of small quantities is not likely to be toxic.		
EYES: Mild irritation, but no corneal injury likely. May cause conjunctivitis.		
EMERGENCY AND FIRST AID PROCEDURES		
EYES AND SKIN Remove contaminated clothing and flush exposed areas with water for 5 to 15 minutes.		
INHALATION Remove to fresh air. If breathing has stopped, administer respiration or oxygen if available.		
INGESTION Do not induce vomiting. Call physician and obtain medical attention.		

VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Evacuate the area, ventilate, avoid breathing vapors, contain spill. Clean up area (wear protective clothing) by mopping or with absorbent material, transfer to closed container.	
WASTE DISPOSAL METHOD Recovered liquids may be sent to a licensed reclaimer or incinerated. Contaminated absorbent material must be disposed of in a permitted waste management facility. Consult federal, state or local disposal authorities for approved procedures.	

VIII - SPECIAL PROTECTION INFORMATION	
SPECIFIC PERSONAL PROTECTIVE EQUIPMENT	
RESPIRATORY	None required when used with adequate ventilation.
EYE	Chemical safety goggles. Contact lenses should not be worn.
SKIN	Neoprene, viton, polyvinyl alcohol coated gloves or equivalent.
OTHER	Protective headgear & apron when splashing is a problem.
VENTILATION REQUIREMENTS Sufficient to maintain below PEL.	

IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Avoid contact with skin & avoid breathing vapors. Pipe vents outdoors. Store in cool, dry, ventilated area. Vapors are heavier than air and will collect in low areas.	
OTHER PRECAUTIONS Prevent moist air from entering storage. No smoking in presence of vapors. Contact with aluminum parts in a pressurizable fluid system may cause violent reactions. Consult equipment supplier for further information.	

MATERIAL SAFETY DATA SHEET

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SECTION I

INDUSTRIAL HYGIENE

<small>Manufacturer's Name</small> TOLBER DIV/PYRAMID PLASTICS, INC.		<small>Emergency Telephone No.</small> (501) 777-3251
<small>Address (Number, Street, City, State and ZIP Code)</small> 220 W. 5th St., Hope, Ark. 71801		
<small>Chemical Name and Synonyms</small> Petroleum Wax		<small>Trade Name</small> IC-562 MICCROWAX
<small>OSHA Classification</small> Not Hazardous		

SECTION II INGREDIENTS

Chemical Name	% Wt.	CAS Registry No.	TLV
Aliphatic Hydrocarbon Wax	100	All chemical substances manufactured for IC-562 Miccrowax by the Tolber Div. have been reported for the chemical substances inventory pursuant to Secs. 8 (a) and 8 (b) of the Toxic substances Control Act (Public Laws 94-469)	

SECTION III PHYSICAL DATA

Melting Point (°F.)	170°F	Specific Gravity (H ₂ O = 1)	.85
Vapor Pressure (mm. Hg)	-----	Percent Volatile By Volume (%)	0
Vapor Density (Air = 1)	-----	Evaporation Rate (Butyl Acetate = 1)	NA
Solubility in Water	NA	pH =	NA

Appearance and Odor **Dark Brown Solid. Petroleum odor**

SECTION IV FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method Used)	500°F	Flammable Limit	Lel	Uel
Extinguishing Media CO₂				
Special Fire Fighting Procedures None				

Unusual Fire and Explosion Hazards **None**

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SECTION V HEALTH HAZARD DATA

Threshold Limit Value NA

Effects of Overexposure NA

Emergency and First Aid Procedures NA

Toxicity Information NA

SECTION VI REACTIVITY DATA

Stability	Unstable		Conditions to Avoid
	Stable	XX	

Incompatibility (Materials to Avoid)

Hazardous Decomposition Products Carbon Monoxide

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur	XX	

SECTION VII SPILL OR LEAK PROCEDURES

Steps to Be Taken in Case Material is Released or Spilled Wipe up after cools

Waste Disposal Method In accordance with state, local and federal regulations for aliphatic hydrocarbon wax.

SECTION VIII SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type) NA

Ventilation	Local Exhaust	Special
-------------	---------------	---------

Protective Gloves	None	Eye Protection	None
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Other Protective Equipment None

SECTION IX SPECIAL PRECAUTIONS

Precautions to be taken in Handling and Storing None

Other Precautions

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Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

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SECTION I

MANUFACTURER'S NAME M. Argueso & Co., Inc.		EMERGENCY TELEPHONE NO. (914) 698-8500
ADDRESS (Number, Street, City, State, and ZIP Code) 441 Waverly Avenue, Mamaroneck, N.Y. 10543		
CHEMICAL NAME AND SYNONYMS Hydrocarbon		TRADE NAME AND SYNONYMS Cerita Masking Wax 361-C
CHEMICAL FAMILY Wax	FORMULA	

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
Telecon 5/22/80 not halogenated					

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)	Above - 700°F.	SPECIFIC GRAVITY (H ₂ O=1)	0.927
VAPOR PRESSURE (mm Hg.)		PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ =1)	
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	Solid material, No odor		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	530°F. Coc, ASTM D-92	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA	Water, CO ₂ , Foam, and Dry Chemical			
SPECIAL FIRE FIGHTING PROCEDURES	None			
UNUSUAL FIRE AND EXPLOSION HAZARDS				

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SECTION V - HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	No Known Effects
EFFECTS OF OVEREXPOSURE	
G. E. PARSONS	
EMERGENCY AND FIRST AID PROCEDURES	
A burn from molten wax should be treated as a thermal burn.	

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE	No	CONDITIONS TO AVOID
	STABLE	Yes	
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Sweep or scrape up material	
WASTE DISPOSAL METHOD	
Burn in approved incinerator or an open pit. (controlled)	

SECTION VIII - SPECIAL PROTECTION INFORMATION			
RESPIRATORY PROTECTION (Specify type)			
None required			
VENTILATION	LOCAL EXHAUST	Adequate	SPECIAL
	MECHANICAL (General)		None
PROTECTIVE GLOVES		Not required	EYE PROTECTION
OTHER PROTECTIVE EQUIPMENT			Nothing special

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
OTHER PRECAUTIONS	

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Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

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Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

MAY 29 1980

G. E. PARSONS

SECTION I

MANUFACTURER'S NAME

Frank B. Ross Co., Inc.

EMERGENCY TELEPHONE NO.

201-433-4512

ADDRESS (Number, Street, City, State, and ZIP Code)

6 Ash Street, Jersey City, N.J. 07304

CHEMICAL NAME AND SYNONYMS

Microcrystalline Wax

CHEMICAL FAMILY

Petroleum

TRADE NAME AND SYNONYMS

ROSS PMC 9952-1 Masking Wax

FORMULA

PMC9551 64-0504

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
Non Hazardous					
not halogenated per D. Ayerlee, Telecon 5/22/80					

SECTION III - PHYSICAL DATA

MELTING POINT (°F.) Melting Point	165/175°F	SPECIFIC GRAVITY (H₂O=1)	0.930
VAPOR PRESSURE (mm Hg.)	---	PERCENT VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (----- *1)	
SOLUBILITY IN WATER	Insoluble		
APPEARANCE AND ODOR	Black Solid		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used) 500° F Min. C.O.C.	FLAMMABLE LIMITS	LSI	USI
EXTINGUISHING MEDIA Foam no water			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS			

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SECTION V - HEALTH HAZARD DATA

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THRESHOLD LIMIT VALUE

EFFECTS OF OVEREXPOSURE

EMERGENCY AND FIRST AID PROCEDURES

Non Hazardous

SECTION VI - REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID

STABLE

INCOMPATIBILITY (Materials to avoid)

HAZARDOUS DECOMPOSITION PRODUCTS

Non Hazardous

HAZARDOUS
POLYMERIZATION

MAY OCCUR

CONDITIONS TO AVOID

WILL NOT OCCUR

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Non Hazardous

WASTE DISPOSAL METHOD

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

VENTILATION

LOCAL EXHAUST

SPECIAL

MECHANICAL (General)

OTHER

PROTECTIVE GLOVES

EYE PROTECTION

OTHER PROTECTIVE EQUIPMENT

Non Hazardous

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

OTHER PRECAUTIONS

Non Hazardous

U.S. DEPARTMENT OF LABOR

PMC 9551

Form No. LSH-005-4
May 1969

WAGE AND LABOR STANDARDS ADMINISTRATION
Bureau of Labor Standards

50-0367

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Tolson Div.
220 West 5th St.
Ft. Smith, Arkansas 71801

MATERIAL SAFETY DATA SHEET

SECTION I

G E PARSONS

MANUFACTURER'S NAME MICHIGAN CHEMICAL CO.		EMERGENCY TELEPHONE NO. (313) 921-3711
ADDRESS (Number, Street, City, State, and ZIP Code) 815 GRINNELL DETROIT, MICH. 48213		
CHEMICAL NAME AND SYNONYMS PETROLEUM BASE HYDROCARBON - ALIPHATIC		TRADE NAME AND SYNONYMS MICROMAX C-500
CHEMICAL FAMILY PETROLEUM WAX	FORMULA NOT A HAZARDOUS MATERIAL	

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
ODORLESS, TASTELESS, NON-TOXIC					
COULD BE FDA QUALIFIED					
not halogenated					

BOILING POINT (°F.) 170°F	SPECIFIC GRAVITY (H ₂ O = 1) .85
WETTING	
VAPOR PRESSURE (mm Hg.)	PERCENT VOLATILE BY VOLUME (5%) -
VAPOR DENSITY (AIR = 1)	EVAPORATION RATE (ASTM D-155) -
SOLUBILITY IN WATER No	
APPEARANCE AND ODOR BROWN ODORLESS	

FLASH POINT (Method used) 500°F		FLAMMABLE LIMITS	
EXTINGUISHING MEDIA		LeI	UoI
SPECIAL FIRE FIGHTING PROCEDURES NONE			
UNUSUAL FIRE AND EXPLOSION HAZARDS FLICKER			

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SECTION VI HEALTH HAZARD DATA	
THRESHOLD LIMIT VALUE	NA
EFFECTS OF OVEREXPOSURE	NA
EMERGENCY AND FIRST AID PROCEDURES	
NA	

SECTION VII REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		
INCOMPATIBILITY (Materials to avoid)			
HAZARDOUS DECOMPOSITION PRODUCTS			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID IMMERSION IN HOT WATER
	WILL NOT OCCUR	X	

SECTION VIII ENVIRONMENTAL HAZARD DATA	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
Wipe up after leaks	
WASTE DISPOSAL METHOD	

SECTION VIII SPECIAL PROTECTION INFORMATION			
RESPIRATORY PROTECTION (Specify type) NONE			
VENTILATION	LOCAL EXHAUST	SPECIAL	
	MECHANICAL (General)	OTHER	
PROTECTIVE GLOVES		EYE PROTECTION	
OTHER PROTECTIVE EQUIPMENT NONE			

SECTION IX SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
NONE	
Can material be stored outside?	
YES	
OTHER PRECAUTIONS	
Is material freezable?	
No	

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ATTACHMENT B

MATERIAL SAFETY DATA SHEETS

CYANIDE SOLUTION

MATERIAL SAFETY DATA SHEET

PENNWALT CORPORATION
METAL PREP DEPARTMENT
2375 STATE ROAD
CORNWELLS HEIGHTS, PA. 19020

EMERGENCY PHONE NUMBERS
BUSINESS HRS: 215-345-3128
OTHER HOURS: SAFETY ENGINEER
CHEMTREC: 800-424-9300

PRODUCT IDENTIFICATION

PRODUCT NAME: CAS NO.: NA-MIXTURE
CLEANER K7
SYNONYMS:
ALKALINE CLEANER
CHEMICAL NAME:
NA-MIXTURE
MOLECULAR FORMULA:
NA-MIXTURE
CHEMICAL FAMILY: STRONG ALKALI

INGREDIENTS-----HAZARD CLASSIFICATIONS

COMPONENTS-HAZARDOUS	CAS NO.	%	COMMENTS
SODIUM METASILICATE	06834-92-0		TWA 10 mg/M3 (NUISANCE DUST) LD50 1280 mg/kg (ORAL-RAT)
SODIUM HYDROXIDE	01310-73-2	80.0	TWA 2 mg/kg (C) PEL 2 mg/M3 EPA has classified aqueous solutions of this material as a SARA 313 reportable chemical.

SHIPPING INFORMATION

CAUSTIC SODA, DRY, MIXTURE; CORROSIVE MATERIAL; UN 1823

PHYSICAL PROPERTIES

BOILING POINT/RANGE:	MELTING POINT:	FREEZING POINT:
NA	NE	NA
MOLECULAR WEIGHT:	SPECIFIC GRAVITY (H2O=1):	VAPOR PRESSURE (MM HG):
NA-MIXTURE	NA	NA
VAPOR DENSITY (AIR=1):	SOLUBILITY IN H2O:	% VOLATILES BY VOLUME:
NA	SOLUBLE	NA
APPEARANCE AND ODOR:		
WHITE, FREE-FLOWING GRANULES		

pH (5 % soln) - >12.0

FIRE AND EXPLOSION DATA

FLASH POINT:	FLAMMABLE LIMITS:	AUTOIGNITION TEMP.:
NA	LOWER: NA UPPER: NA	NA

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

EXTINGUISHING MEDIA:WATER- WATER-
SPRAY FOG

SPECIAL FIRE FIGHTING PROCEDURES:

Wear Self Contained Breathing Apparatus. Cool fire exposed containers with water.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NA

REACTIVITY DATA

STABILITY: CONDITIONS CONTRIBUTING TO INSTABILITY: NA

STABLE

Hazard Rating (NFPA 704M): EXTREME 4 HIGH 3 MODERATE 2
SLIGHT 1 LEAST 0
-----HEALTH (BLUE) 3
FLAMMABILITY (RED) 0
REACTIVITY (YELLOW) 0

INCOMPATIBILITY-AVOID CONTACT WITH:

STRONG
ACIDS

HAZARDOUS DECOMPOSITION THERMAL AND OTHER: NA

CONDITIONS TO AVOID:

This product liberates a great deal of heat when added to water. To avoid rapid temperature rise, violent spattering or explosive eruptions, *ALWAYS* ADD PRODUCT TO WATER. *NEVER* ADD WATER TO PRODUCT.

THE FOLLOWING MIXING PROCEDURE SHOULD BE USED:

1. Heat water to 80 - 100 DEG F before adding product.
2. Add small amounts of product slowly and evenly while constantly mixing solution. Never increase concentration of product in solution by more than five percent with any single addition. Water temperature should not exceed 160 DEG F during addition.

TOXICITY

ROUTE	ANIMAL	DATA
ORAL	ACUTE - SODIUM HYDROXIDE	LD50- 340 mg/kg (ORAL-RAT)
DERMAL	ACUTE - SODIUM HYDROXIDE	LD50- 1350 mg/kg (ORAL-RAT)

TOXIC EFFECTS

EYE EFFECTS: CORROSIVE

Causes rapid tissue destruction, permanent damage and possible blindness.

SKIN EFFECTS: CORROSIVE

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

Solids or dust will cause skin irritation. Prolonged exposure will cause irreversible scarring.

OTHER TOXIC EFFECTS:

This product does not contain any components listed by IARC, NTP or OSHA as carcinogens.

TARGET ORGAN TOXIN:

Ingestion may cause severe burns of the mouth and throat. Prolonged exposure to skin will cause irreversible scarring.
Dust inhalation can cause burns to the mucous membranes.

TOXICITY COMMENTS:

Individuals with breathing difficulty may find exposure to this product increases that difficulty. Such individuals should pay special attention to the recommended exposure limits for hazardous ingredients.

HEALTH HAZARD INFORMATION

PERMISSIBLE EXPOSURE LIMITS

Since this product is a mixture, there is no exposure limit established for it. Hazardous components and their associated permissible exposure limits are listed in the section titled 'INGREDIENTS-----HAZARD CLASSIFICATIONS'.

EMERGENCY FIRST AID

INGESTION

DO NOT INDUCE VOMITING	GIVE PLENTY OF WATER	GET MEDICAL ATTENTION
---------------------------	-------------------------	--------------------------

DO NOT INDUCE VOMITING. GIVE PLENTY OF WATER OR MILK. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET IMMEDIATE MEDICAL ATTENTION.
NOTE TO PHYSICIAN: PROBABLE MUCOSAL DAMAGE MAY CONTRAINDICATE THE USE OF GASTRIC LAVAGE. MEASURES AGAINST CIRCULATORY SHOCK, RESPIRATORY DEPRESSION AND CONVULSION MAY BE NEEDED

DERMAL

WASH WITH SOAP AND WATER	GET MEDICAL ATTENTION	CONTAMINATED CLOTHING REMOVE & LAUNDER	CONTAMINATED SHOES - DESTROY
-----------------------------	--------------------------	--	---------------------------------

EYE CONTACT

FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES	GET MEDICAL ATTENTION
---	--------------------------

IMMEDIATELY AND CONSTANTLY FLUSH EYES (HOLDING EYELIDS OPEN) WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES OR UNTIL MEDICAL TREATMENT IS RECEIVED. WHILE FLUSHING, REMOVE CONTAMINATED CLOTHING AND SHOES AND DESTROY. GET EMERGENCY MEDICAL ATTENTION

NA - NOT APPLICABLE

NE - NOT ESTABLISHED

(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

PM 1256

INHALATION

REMOVE TO
FRESH AIRIF NOT BREATHING
GIVE ARTIFICIAL
RESPIRATION*****
SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS:

LOCAL EXHAUST USE WITH ADEQUATE
VENTILATIONMaintain ventilation sufficient to reduce the level of hazardous
ingredient(s) below the stated concentration level(s).

EYE: FACE SHIELD GOGGLES

Contact lenses should NEVER be worn when working with this or any
chemical.

HAND (GLOVE TYPE): ANY NON-PERMEABLE TO PRODUCT

RESPIRATOR TYPE: CARTRIDGE

FILTERS DUST

Respiratory protection should be worn if the level of airborne
contamination exceeds the level(s) listed above. Air quality should
always be improved first by engineering solutions (such as better
ventilation), and then by using respiratory protection if the
engineering solution is unsuccessful.

OTHER PROTECTIVE EQUIPMENT:

RUBBER BOOTS APRON

SPECIAL HANDLING AND STORAGE CONDITIONSWASH THOROUGHLY DO NOT GET IN EYES, DO NOT BREATHE
AFTER HANDLING ON SKIN OR CLOTHING DUST, VAPOR, MIST, GASKEEP CONTAINER
CLOSED*****
SPILL MANAGEMENTFLUSH WITH SWEEP OR SCOOP
WATER UP AND REMOVE

Flush residue with water, to chemical waste treatment.

DISPOSAL PROCEDURESDissolve slowly in water. Carefully neutralize with dilute acid and
flush to chemical waste drain.

CONSULT FEDERAL, STATE, OR LOCAL AUTHORITIES FOR PROPER DISPOSAL PROCEDURES

NA - NOT APPLICABLE

NE - NOT ESTABLISHED

(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

MSDS PREPARED BY H.D.McLaughlin Jr.

THE ABOVE INFORMATION IS ACCURATE TO THE BEST OF OUR KNOWLEDGE. HOWEVER, SINCE DATA, SAFETY STANDARDS, AND GOVERNMENT REGULATIONS ARE SUBJECT TO CHANGE AND THE CONDITIONS OF HANDLING AND USE, OR MISUSE ARE BEYOND OUR CONTROL, PENNWALT MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN AND DISCLAIMS ALL LIABILITY FOR RELIANCE THEREON. USER SHOULD SATISFY HIMSELF THAT HE HAS ALL CURRENT DATA RELEVANT TO HIS PARTICULAR USE.

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

UTC
I. H. Lab

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Form Approved
OMB No. 44-R1387

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MATERIAL SAFETY DATA SHEET

PMC 1256

Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

Phone:

rec'd - 4-24-79

756-5521		SECTION I	
MANUFACTURER'S NAME HUBBARD HALL CHEMICAL CO.		EMERGENCY TELEPHONE NO. 203-756-5521	
ADDRESS (Number, Street, City, State, and ZIP Code) 563 South Leonard Street, Waterbury, Connecticut 06714			
CHEMICAL NAME AND SYNONYMS		TRADE NAME AND SYNONYMS HHCleaner 200-P.W.A.	
CHEMICAL FAMILY Mixture of alkaline salt & surfactants.		FORMULA Old Name: Alcoloid #200 Cleaner	

SECTION II - HAZARDOUS INGREDIENTS					
PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS		NA	BASE METAL		NA
CATALYST		NA	ALLOYS		NA
VEHICLE		NA	METALLIC COATINGS		NA
SOLVENTS		NA	FILLER METAL PLUS COATING OR CORE FLUX		NA
ADDITIVES		NA	OTHERS		
OTHERS		NA			
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)
Caustic Soda (excess of)				50	2MG/M ³

SECTION III - PHYSICAL DATA			
BOILING POINT (°F.)	N. A.	SPECIFIC GRAVITY (H ₂ O=1)	
VAPOR PRESSURE (mm Hg.)	N. A.	PERCENT VOLATILE BY VOLUME (%)	N. A.
VAPOR DENSITY (AIR=1)	N. A.	EVAPORATION RATE (--- 1)	N. A.
SOLUBILITY IN WATER	Appreciable		
APPEARANCE AND ODOR	White or off - white granular		

SECTION IV - FIRE AND EXPLOSION HAZARD DATA			
FLASH POINT (Method used)	N. A.	FLAMMABLE LIMITS	LeI UeI
EXTINGUISHING MEDIA	Not Flammable		
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS			
Will release flammable Hydrogen gas when in contact with aluminum, tin, zinc and their alloys. Can react violently with some organic chemicals including chlorinated hydrocarbons			

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OFFICE LOCAL IAM

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PMC 1256

HH Cleaner 200

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE Value for sodium hydroxide is 2 mg/M₃ (ACGIH-1970)

EFFECTS OF OVEREXPOSURE Skin: May cause severe burns. Eyes: Rapidly causes severe damage to eyes. Ingestion will damage tissues and can cause death. Dust inhalation may damage respiratory tract.

EMERGENCY AND FIRST AID PROCEDURES Speed in removal of caustic is of primary importance. Skin: Flush with large amounts of water up to 1 or 2 hours. Eyes: Irrigate immediately with copious amounts of water for at least 15 min. Ingestion: Drink large amounts of water to dilute the chemical. Get physician's treatment at once for eye skin burns. and if ingested or inhaled

SECTION VI - REACTIVITY DATA

STABILITY

UNSTABLE

CONDITIONS TO AVOID

STABLE

X

INCOMPATIBILITY (Materials to avoid) Aluminum, zinc, tin, organic chemicals including chlorinated hydrocarbons such as trichloroethylene.

HAZARDOUS DECOMPOSITION PRODUCTS

NA

HAZARDOUS
POLYMERIZATION

MAY OCCUR

CONDITIONS TO AVOID

WILL NOT OCCUR

X

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED Sweep up carefully and remove.

Dissolve and flush away remainder. Dilute acid, preferably acetic acid, may be used to neutralize final caustic traces.

WASTE DISPOSAL METHOD If disposal regulations permit discharge of neutral solution dissolve in water, cool neutralize carefully with dilute acid such as acetic. Then flush to sewer with lots of water. Disposal by a contractor may otherwise be needed.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)

Filter or dust type respirators.

VENTILATION

LOCAL EXHAUST

SPECIAL

As necessary to eliminate dust.

MECHANICAL (General)

Good ventilation is essential

OTHER Safety showers in work area.

PROTECTIVE GLOVES

Rubber, neoprene or vinyl

EYE PROTECTION

Chemical Safety Goggles

OTHER PROTECTIVE EQUIPMENT

Face shields, hard hats, rubber aprons, boots or shoes and rubber clothing as necessary to prevent skin contact

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING

Do not mix with hot water.

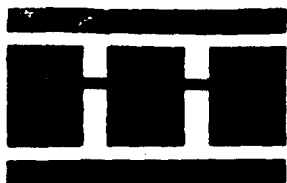
Add a cleaner slowly and carefully to cold water with stirring, as heat is evolved. Heat is also evolved in neutralizing.

OTHER PRECAUTIONS

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PRODUCT BULLETIN

HH CLEANER 200 PWA - Old Name: Alkaloid

HH Cleaner 200 PWA is an extra heavy duty anodic alkaline electrocleaner for steel, copper and copper plated steel.

HH Cleaner 200 PWA has been formulated so that it may also serve as a soak electrocleaner in shops and plants where the cycle is limited to a few steps.

HH Cleaner 200 PWA may serve as a general purpose soak electrocleaner for the removal of such soils as: stamping oils, water soluble fabrication compounds, polishing and grinding compounds and cutting and drawing lubricants.

Furthermore, because of its unique formulation, HH Cleaner 200 PWA should be considered for applications where smutted steel is encountered.

The advantages of HH Cleaner 200 PWA are:

1. High Conductivity.
2. Free rinsing - will perform equally well in hard water areas.
3. Non dusting - free flowing powder.
4. May serve as soak-electrocleaner.

Operating Conditions

Concentrations: 8 to 32 oz/gal. (60 to 240 gms/l)

Temperatures: 140° - 205° F. (60° - 91° C.)

Current Densities: 60 to 100 amps/ft² (6 to 10 amps/dm²)

Equipment: Mild steel tanks, anodes and coils.

Ventilation: Required when used as an electrocleaner.

Control

Titration Procedure

factor (oz/gal.) 0.33

factor (gms/l) 2.46

Use 10 ml sample, N/2 HCL, 3 drops phenolphthalein indicator.

Concentration 200 PWA = ml's N/2 HCL x factor

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PMC 1256

HH CLEANER 200 PWA

CONTINUED

-2-

Test Kit Procedure (Kocour test kit)

factor (oz/gal.) 0.42

factor (gms/l) 3.16

Conc. 200 PWA = drops N-94 solution x factor

Waste Disposal

Neutralize solutions of cleaner 200 PWA to a pH between 6 to 8 with a mineral acid. Use caution when adding the acid since neutralization generates heat. Discharge the neutralized solution to a sewer or settling lagoon.

In order to be completely informed on the latest disposal regulations for your area, please contact the local authorities.

Caution

HH Cleaner 200 PWA is a highly alkaline product, thus should be handled accordingly. Avoid skin and eye contact. Wear protective clothing, gloves and goggles. Flush exposed areas immediately with clean cold water. In case of injury contact a doctor immediately.

Standard packages - 400# drum

Warranty:

This product is guaranteed as to quality upon shipment from our plant. If the recommendations are followed, desired results will be obtained. Since the use of our products is beyond our control, no guarantee expressed or implied is made as to the effects of such use, or the results to be obtained.

Replaces sheet dated 11/10/76

5/22/78

PMC 1256-1

PENNVAL
.....

MATERIAL SAFETY DATA SHEET

ESSENTIALLY SIMILAR
FORM 4040 (REV. 8-81)

ADDRESS: Pennval Corporation
900 First Avenue
King of Prussia, PA 19406

Pennval Product Name

K-7

MAY 27 1986
PENNVAL CODE NO
B01

Chemical Name and Molecular Formula

RECEIVED

SAFETY
MIDDLETOWN

Emergency Phone Number(s)

Business: (215) 337-6634

Other:

Synonyms
10

MAY 27 1986

CAS No.(s)

See below

PRODUCT IDENTIFICATION

INDUSTRIAL HYGIENE

Chemical Family

Strong Alkali

MATERIALS OR COMPONENTS

HAZARD DATA (TLV, LD50, LC50, etc.)

HAZARDOUS INGREDIENTS

Sodium Hydroxide (1310-73-2)
Sodium Silicate (6834-92-0)<80.0 TWA 2 mg/m³ (C)
<20.0 TWA 10 mg/m³ (nuisance particulate)

SHIPPING INFORMATION

Caustic Soda, Dry, Mixture; Corrosive Material; UN 1823

PHYSICAL PROPERTIES

Boiling Point/Range °C NA °F ND °C °F NA °C °F NA °C °F Mixture

Specific Gravity (H₂O=1) @ / °C NA @ °C °F NA

Solubility in H₂O % Volatiles by Volume NA

Soluble NA

Appearance and Odor Other -

White free flowing granules

FIRE AND EXPLOSION DATA

Flash Point None °C °F Test Method Lower % Upper % Autoignition Temperature/Fire Point °C NA °F

EXTINGUISHING MEDIA ☒ water ☒ water foam ☐ CO₂ ☐ Dry Chemical ☐ Alcohol ☐ Foam ☐ Earth or sand

SPECIAL FIRE FIGHTING PROCEDURES ☐ Do not enter ☐ Allow fire to burn ☐ water may cause frothing ☐ Do not use water NA

UNUSUAL FIRE AND EXPLOSION HAZARDS ☐ Sensitive to shock ☐ Contamination ☐ Temperature ☐ Other (specify): NA

REACTIVITY DATA

STABILITY ☒ Stable ☐ Unstable

CONDITIONS CONTRIBUTING TO INSTABILITY ☐ Thermal decomposition ☐ Photo degradation ☐ polymerization ☐ Contamination

INCOMPATIBILITY - Avoid contact with ☒ Strong acids ☐ Strong alkalis ☐ Strong oxidizers ☐ Other (specify):

HAZARDOUS DECOMPOSITION PRODUCTS - THERMAL AND OTHER (H₂) Thermal - Oxides of Carbon

SPILL OR LEAK

CONDITIONS TO AVOID ☐ Heat ☐ Open flames ☐ Sparks ☐ Ignition sources ☐ Other (specify):

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED ☐ Flush with water ☐ Absorb with sand or inert material ☐ Neutralize ☒ Sweep or scoop up and remove ☐ Keep upwind. Evacuate enclosed spaces. ☐ Prevent spread or spill

WASTE DISPOSAL METHOD - Consult federal, state, or local authorities for proper disposal procedures.

CONTINUED ON
REVERSE SIDE

NA - Not Applicable.

Before using product, read and follow directions and precautions on product label and bulletins.

TOXICITY	Oral (acute)	NE		Pmc 1256-1	
	Dermal (acute)	NE			
	Eye	NE		Inhalation (acute)	NE
	Chronic, Subchronic, etc.				
HEALTH HAZARD INFORMATION	PERMISSIBLE EXPOSURE LIMIT (Specify if TLV/TWA or Ceiling (c))				
	ACGIH 19		OSHA 19		Other:
	IRRITATION	<input type="checkbox"/> Skin	<input type="checkbox"/> Severe	<input type="checkbox"/> Moderate	<input type="checkbox"/> Mild (transient)
	NA	<input type="checkbox"/> Eye	<input type="checkbox"/> Severe	<input type="checkbox"/> Moderate	
	CORROSIVITY	<input checked="" type="checkbox"/> Skin	<input checked="" type="checkbox"/> 4 hrs. (DOT)	<input type="checkbox"/> 24 hrs. (CPSC)	
		<input checked="" type="checkbox"/> Eye	<input checked="" type="checkbox"/> May cause blindness		
	SENSITIZATION		INHALATION EFFECTS		
	<input type="checkbox"/> Skin	NA	<input type="checkbox"/> Respiratory	<input type="checkbox"/> Allergen	<input type="checkbox"/> Narcotic effect
	LUNG EFFECTS (Specify):		NA		
	OTHER (Specify):		NA		
SPECIAL PROTECTION INFORMATION	INGESTION				
	<input type="checkbox"/> Induce vomiting	<input checked="" type="checkbox"/> Do NOT induce vomiting	<input checked="" type="checkbox"/> Give plenty of water	<input checked="" type="checkbox"/> Get medical attention	<input type="checkbox"/> Other (specify):
	DERMAL				
	<input checked="" type="checkbox"/> Flush with soap and water	<input checked="" type="checkbox"/> Get medical attention	<input type="checkbox"/> Contaminated clothing - remove & launder	<input type="checkbox"/> Contaminated shoes - destroy	<input type="checkbox"/> Other (specify):
	EYE CONTACT				
	<input checked="" type="checkbox"/> Flush with plenty of water for at least 15 minutes	<input checked="" type="checkbox"/> Get medical attention	<input checked="" type="checkbox"/> Other (specify): Hold eyelids open while flushing		
	INHALATION				
	<input checked="" type="checkbox"/> Remove to fresh air	<input type="checkbox"/> If not breathing, give artificial respiration	<input type="checkbox"/> Give oxygen	<input type="checkbox"/> Get medical attention	<input type="checkbox"/> Other (specify):
	VENTILATION REQUIREMENTS - Always maintain exposure below permissible exposure limits				
	<input type="checkbox"/> Consult an industrial hygienist or environmental health specialist	<input checked="" type="checkbox"/> Local exhaust	<input type="checkbox"/> Use with adequate ventilation	<input type="checkbox"/> Check for air contaminant and oxygen deficiency	
Sufficient to maintain level below the specified hazardous ingredient concentration limit.					
SPECIAL PRECAUTIONS	EYE				
	<input type="checkbox"/> Safety glasses	<input checked="" type="checkbox"/> Face shield	<input type="checkbox"/> Other (specify):		
	HAND (GLOVE TYPE)				
	<input type="checkbox"/> Polyvinyl chlorides	<input checked="" type="checkbox"/> Nitrile	<input checked="" type="checkbox"/> Butyl rubber	<input type="checkbox"/> Polyvinyl alcohol	<input type="checkbox"/> Polyethylene
	RESPIRATOR TYPE - Use only NIOSH approved equipment				
<input type="checkbox"/> Self-contained					
<input type="checkbox"/> Supplied air					
<input type="checkbox"/> Can or cartridge gas or vapor					
<input checked="" type="checkbox"/> Filter - dust, fume, mist					
<input type="checkbox"/> Other (specify):					
OTHER PROTECTIVE EQUIPMENT					
<input checked="" type="checkbox"/> Rubber boots					
<input checked="" type="checkbox"/> Apron					
<input type="checkbox"/> Other (specify):					
PRECAUTIONARY LABELING					
<input checked="" type="checkbox"/> Wash thoroughly after handling					
<input checked="" type="checkbox"/> Do not get in eyes, on skin or clothing					
<input checked="" type="checkbox"/> Do not breathe dust, vapor, mist, gas					
<input type="checkbox"/> Keep container closed					
<input type="checkbox"/> Keep away from heat, sparks, and open flames					
<input type="checkbox"/> Store in tightly closed containers					
<input type="checkbox"/> Do not store near combustibles					
<input type="checkbox"/> Keep from contact with clothing and other combustible materials					
<input type="checkbox"/> Empty container may contain hazardous residues					
<input type="checkbox"/> Use explosion proof equipment					
<input type="checkbox"/> Other (specify):					
Other handling and storage conditions:					
Minimum contact with this and all chemicals is recommended as a good general policy to follow.					
Prepared by: Hugh D. McLaughlin, Jr. Date: 10/85 Address: 900 First Avenue, King of Prussia, PA 19406 Phone: (215) 337-6634					
PLEASE NOTE ▶ "The above information is accurate to the best of our knowledge. However, since data, safety standards, and government regulations are subject to change and the conditions of handling and use, or misuse are beyond our control, Pennwalt MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE COMPLETENESS OR CONTINUING ACCURACY OF THE INFORMATION CONTAINED HEREIN AND DISCLAIMS ALL LIABILITY FOR RELIANCE THEREON. User should satisfy himself that he has all current data relevant to his particular use."					

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PENNWALT CORPORATION

MSDS

PROJECT CODE: 05057. 1
DATE: 5/25/88 PAGE: 1

PMC 1256
MATERIAL SAFETY DATA SHEET

PENNWALT CORPORATION
METAL PREP DEPARTMENT
2375 STATE ROAD
CORNWELLS HEIGHTS, PA. 19020

EMERGENCY PHONE NUMBERS
BUSINESS HRS: 215-245-3128
OTHER HOURS:
CHEMTREC: 800-424-9300

PRODUCT IDENTIFICATION

PRODUCT NAME: CAS NO.: NA-MIXTURE
CLEANER K7
SYNONYMS:
ALKALINE CLEANER
CHEMICAL NAME:
NA-MIXTURE
MOLECULAR FORMULA:
NA-MIXTURE
CHEMICAL FAMILY: STRONG ALKALI

RECEIVED

JUN 13 1988

INDUSTRIAL HYGIENE

INGREDIENTS-----HAZARD CLASSIFICATIONS

COMPONENTS	CAS NO.	%	COMMENTS
SODIUM HYDROXIDE	01310-73-2		TWA 2 mg/kg (C) PEL 2 mg/M3
SODIUM METASILICATE	06834-92-0		TWA 10 mg/M3 (NUISANCE DUST) LD50 1280 mg/kg (ORAL-RAT)
=====			
Hazard Rating (NFPA 704M)			EXTREME 4 MODERATE 2 HIGH 3 SLIGHT 1 LEAST 0
			=====
			HEALTH (BLUE) 3 FLAMMABILITY (RED) 0 REACTIVITY (YELLOW) 0

SHIPPING INFORMATION

CAUSTIC SODA, DRY, MIXTURE; CORROSIVE MATERIAL; UN 1823

PHYSICAL PROPERTIES

BOILING POINT/RANGE:	MELTING POINT:	FREEZING POINT:
NA	NE	NA
MOLECULAR WEIGHT:	SPECIFIC GRAVITY(H2O=1):	VAPOR PRESSURE(MM HG):
NA-MIXTURE	NA	NA
VAPOR DENSITY(AIR=1):	SOLUBILITY IN H2O:	% VOLATILES BY VOLUME:
NA	SOLUBLE	NA
APPEARANCE AND ODOR:		
WHITE, FREE-FLOWING GRANULES		

pH (5 % soln) - >12.0

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

FIRE AND EXPLOSION DATA

FLASH POINT:
NAFLAMMABLE LIMITS:
LOWER: NA UPPER: NAAUTOIGNITION TEMP.:
NAEXTINGUISHING MEDIA:
WATER- WATER-
SPRAY FOG

SPECIAL FIRE FIGHTING PROCEDURES:

Wear Self Contained Breathing Apparatus. Cool fire exposed containers with water.

UNUSUAL FIRE AND EXPLOSION HAZARDS: NA

REACTIVITY DATASTABILITY:
STABLE

CONDITIONS CONTRIBUTING TO INSTABILITY: NA

INCOMPATIBILITY-AVOID CONTACT WITH:
STRONG
ACIDS

HAZARDOUS DECOMPOSITION THERMAL AND OTHER: NA

CONDITIONS TO AVOID:

This product liberates a great deal of heat when added to water. To avoid rapid temperature rise, violent spattering or explosive eruptions, *ALWAYS* ADD PRODUCT TO WATER. *NEVER* ADD WATER TO PRODUCT.

THE FOLLOWING MIXING PROCEDURE SHOULD BE USED:

1. Heat water to 80 - 100 DEG F before adding product.
2. Add small amounts of product slowly and evenly while constantly mixing solution. Never increase concentration of product in solution by more than five percent with any single addition. Water temperature should not exceed 160 DEG F during addition.

TOXICITY

ROUTE	ANIMAL	DATA
ORAL	ACUTE - SODIUM HYDROXIDE LD50-	340 mg/kg (ORAL-RAT)
DERMAL	ACUTE - SODIUM HYDROXIDE LD50-	1350 mg/kg (ORAL-RAT)

TOXIC EFFECTS

EYE EFFECTS: CORROSIVE

Causes rapid tissue destruction, permanent damage and possible blindness.

SKIN EFFECTS: CORROSIVE

Solids or dust will cause skin irritation. Prolonged exposure will cause irreversible scarring.

NA - NOT APPLICABLE

NE - NOT ESTABLISHED

(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

OTHER TOXIC EFFECTS:

This product does not contain any components listed by IARC, NTP or OSHA as carcinogens.

TARGET ORGAN TOXIN:

Ingestion may cause severe burns of the mouth and throat. Prolonged exposure to skin will cause irreversible scarring.
Dust inhalation can cause burns to the mucous membranes.

TOXICITY COMMENTS:

WARNING: This product contains a chemical known to the State of California to cause birth defects or other reproductive harm.

HEALTH HAZARD INFORMATION

PERMISSIBLE EXPOSURE LIMITS

Since this product is a mixture, there is no exposure limit established for it. Hazardous components and their associated permissible exposure limits are listed in the section titled 'INGREDIENTS-----HAZARD CLASSIFICATIONS'.

EMERGENCY FIRST AID

INGESTION

DO NOT INDUCE VOMITING	GIVE PLENTY OF WATER	GET MEDICAL ATTENTION
---------------------------	-------------------------	--------------------------

DO NOT INDUCE VOMITING. GIVE PLENTY OF WATER OR MILK. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON. GET IMMEDIATE MEDICAL ATTENTION.
NOTE TO PHYSICIAN: PROBABLE MUCOSAL DAMAGE MAY CONTRAINDICATE THE USE OF GASTRIC LAVAGE. MEASURES AGAINST CIRCULATORY SHOCK, RESPIRATORY DEPRESSION AND CONVULSION MAY BE NEEDED

Dermal

WASH WITH SOAP AND WATER	GET MEDICAL ATTENTION	CONTAMINATED CLOTHING REMOVE & LAUNDRER	CONTAMINATED SHOES - DESTROY
-----------------------------	--------------------------	---	---------------------------------

EYE CONTACT

FLUSH WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES	GET MEDICAL ATTENTION
---	--------------------------

IMMEDIATELY AND CONSTANTLY FLUSH EYES (HOLDING EYELIDS OPEN) WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES OR UNTIL MEDICAL TREATMENT IS RECEIVED. WHILE FLUSHING, REMOVE CONTAMINATED CLOTHING AND SHOES AND DESTROY. GET EMERGENCY MEDICAL ATTENTION

INHALATION

REMOVE TO FRESH AIR	IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION
------------------------	--

SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS:

LOCAL EXHAUST USE WITH ADEQUATE
VENTILATION

NA - NOT APPLICABLE

NE - NOT ESTABLISHED

(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

Maintain ventilation sufficient to reduce the level of hazardous ingredient(s) below the stated concentration level(s).

EYE: FACE SHIELD GOGGLES

Contact lenses should NEVER be worn when working with this or any chemical.

HAND (GLOVE TYPE): ANY NON-PERMEABLE TO PRODUCT

RESPIRATOR TYPE: CARTRIDGE

FILTERS DUST

Respiratory protection should be worn if the level of airborne contamination exceeds the level(s) listed above. Air quality should always be improved first by engineering solutions (such as better ventilation), and then by using respiratory protection if the engineering solution is unsuccessful.

OTHER PROTECTIVE EQUIPMENT:

RUBBER BOOTS APRON

SPECIAL HANDLING AND STORAGE CONDITIONS

WASH THOROUGHLY DO NOT GET IN EYES, DO NOT BREATHE
AFTER HANDLING ON SKIN OR CLOTHING DUST, VAPOR, MIST, GAS

KEEP CONTAINER
CLOSED

SPILL MANAGEMENT

FLUSH WITH SWEEP OR SCOOP
WATER UP AND REMOVE

Flush residue, with water, to chemical waste treatment.

DISPOSAL PROCEDURES

Dissolve slowly in water. Carefully neutralize with dilute acid and flush to chemical waste drain.

CONSULT FEDERAL, STATE, OR LOCAL AUTHORITIES FOR PROPER DISPOSAL PROCEDURES

MSDS PREPARED BY H.D. McLaughlin Jr.

NA - NOT APPLICABLE NE - NOT ESTABLISHED
(R) - INDICATES REGISTERED TRADEMARK OF PENNWALT CORPORATION

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NA - NOT APPLICABLE NE - NOT ESTABLISHED
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